ENGINEERING NEWS

THE MITKIEWICZ-BARKER Chinese banking, railway and telephone concession has been ratified by the Chinese Minister at Washington. And it is understood that $25,000,000 is the amount of capital to be invested, and report has it that Mr. WHARTON BARKER and some of his associates will go to China this Fall to at once organize a national bank and lay out plans for the first railroad, which will probably be a strategical one for the transport of troops chiefly.

THE Pennsylvania R. R. Co. is erecting upon its Harsimus Cove branch, in Jersey City, the iron double track bridge lately removed from the Conestoga Creek crossing on the main line in Pennsylvania. Some people think this is a preliminary to the change in terminal station in Jersey City. But it is not at all probable that the company would put upon so important a portion of the line a structure rejected on its main line. The tracks will more probably be elevated on Greene street, the present line, in spite of the local opposition and delay of the City Board of Control, and Greene street will be vacated. The sacrifice of the public interests by a change of terminal would otherwise be great, and, as the old surface line would be used for freight, the public would gain nothing at the present very dangerous grade crossing at Greene street.

THE Utica viaduct, now under construction, and intended to connect the Ontario and Rome, Watertown and Ogdensburg railways, will be a work of considerable novelty from the form and character of its curves. The viaduct will be 718 ft. long, and cross 20 ft. above the tracks of the New York Central and Delaware, Lackawanna & Western R. R's. It will be built of iron resting upon stone piers founded on piles. The line includes a tangent merging into a 2° curve which reverses into a curve of 9° which itself compounds into one of 11°. A. J. SWIFT, Chief Engineer of the Delaware & Hudson Canal Company, was the designer of the ironwork

WE witnessed last Saturday the operation of the machines and system of street cleaning now being perfected by the National Street Sweeping Machinery Co., of 330 Walnut street, Philadelphia. The cardinal idea of the system is the elimination of hand labor from every part of the operation and the performance of the work by horse-power, thus lessening the expense so much that the cost of clean streets is brought down to a reasonable amount. The machines were operated upon three kinds of pavement, asphalt, Belgian block and Philadelphia's notorious cobble stones; on each of which they demonstrated their ability to perform satisfactory work. Some defects in the working of the conveyor belt of the combined sweeper and loader were due to faults of mechanical detail which the inventor proposes to obviate by slight changes in the construction. The general principle of the design is a very good one and well worth the attention of those interested in street cleaning work. We intend soon to give a full description of the company's system with illustrations of their machines, which have been entirely remodelled since first brought to our notice some months ago, and will defer more extended notice of the work until then. We will only add that the principle of the machine is to throw the dirt from the gutter (cleaning that troublesome portion thoroughly) towards the center of the street, and then to clean the street by a combined sweeper and loader without the intervention of hand labor. As a sample of the task attempted in this test, we might mention that nearly 100 cu. ft. of dirt were gathered up in the length of two blocks; the streeet probably not having been swept before for a year. Bad as these conditions are, the managers of the company are preparing to deal with them.

THE magnitude of proposed improvements on the line of the Penna. R. R. is indicated by the fact that out of the $8,000,000 lately received from the issue of new stock, $1,200,000 is set apart for the purchase of new engines and cars alone; 60 new locomotives and 150 passenger cars are to be built and owned by the company. Since Jan. 1, last, it is said that over 11,000 freight cars have been provided under the new car-trust fund of $11,000,000 bearing 4 per cent interest

THE Baltimore & Ohio R. R. Co. has been awakened by its late Washington accident, and is reported to have decided to equip its passenger cars with the Westinghouse automatic air-brake to replace the present non-automatic Loughridge brakes. A better system of signals is also to be introduced.

FOLLOWING the general rule in such cases, the late Chatsworth accident has already produced its crop of "preventatives." Among these we note a pioneer locomotive sent ahead of all excursion trains; and the proposer rather sagely remarks that as this is the ordinary practice with trains carrying a dead President, he sees no reason why any number of possible future Presidents should not be cared for in the same way. Another inventive genius suggests the running of a net work of small pipes filled with mercury around all the exposed members of a wooden culvert, with electrical appliances so attached that in case of fire, the mercury will expand, complete an electrical circuit and send the news to the nearest station. And still another philanthropist pictures his invention in the *Scientific American*. He would punch the roof of a car full of trap doors, which can be released from within, and his illustration graphically depicts the passengers swarming out of these holes in a series of cars which have smashed up in just the right way—which is a way very seldom seen in actual practice.

THE Atlantic system of the Southern Pacific R. R. has been doing some bridge moving after the fashion of the Pennsylvania R. R. The bridge over the San Jacinto river, 160 ft. span and weighing 130 tons, was moved 19 ft. horizontally and 5 ft. vertically to fit it in the center of a new trestle work, 2,100 ft. long, to accommodate a change in line.

THE most serious railroad accident of the week was caused, September 3, by a misplaced switch on the Leavenworth branch of the Union Pacific Railroad, near Lawrence Junction, Kan. The engineer of the freight train should have stopped at this switch, but being new to the road he was running at a speed of 15 or 18 miles an hour. The engine jumped the switch, ran for some distance alongside the track and turned over. Several cars were wrecked and nearly all the drawheads were broken. Three men were killed.

DURING the week there have been heavy rains and floods in Texas, and much damage has been done to towns and the crops. Washouts have occurred on the Missouri Pacific, Houston & Texas Central, and several other railroads. All the bridges in Hill county and about 16 railroad bridges in different parts of the State, are reported wrecked. Heavy rains and floods have also been experienced in Nebraska. A washout has occurred on the Sonora Railway, near Nogales, Cal. An earthquake shock was reported from Tucson, Ariz., on September 1.

THE following bridge accidents are reported:—On August 29 the Oldham trestle, near Cambridge, O., on the Cleveland & Marietta Railroad, was burnt. A freight train which could not be stopped in time, had nearly passed over when 60 ft. of the trestle fell, and three cars were wrecked. One man was fatally injured.——On September 2, the engine of the east bound Leadville express went through the Beaver Creek bridge, between Salida and Pueblo, Col. The accident was due to a rock falling from the side of the cañon and crashing through the bridge. Three men were killed and several injured.

THE Minnesota & Northwestern R. R. is said to be meeting with such difficulty in an attempt to tunnel a blue clay bluff, in Rice township, Illinois, that the company is debating the feasibility of making it an open cut by plowing and scraping it down to grade. The clay is reported as being proof against pick, shovel and dynamite.

CLEVELAND, O., is experimenting with underground cables, and has just ordered 6,000 ft. of single wire cable for the fire alarm telegraph. This wire is to be laid in a 6-in. sewer-pipe buried 3½ ft. deep.

THE *Chiffonniers* of Paris have established a *bourse*, or exchange, of their own. This seems an odd movement, but *Le Genié Civil* gives some statistics which show the extent of the interests represented. Each year the rag-pickers of Paris gather up over 954,000,000 lbs. of material that would be otherwise wasted, and by their industry alone, about $5,000,000 is annually saved to the community. This matter is marketed by 420 dealers in rags and old paper, and about 1,000 men and 12,000 women are engaged in collecting it. Then there are about 5,500 collectors of second-hand clothing, with 2,000 regularly established dealers therein. The aggregate then is a mercantile community of 21,000 souls regularly engaged in collecting rags, old paper and old clothing. If to these are added all the minor assistants utilized in the collection and disposal of this and kindred material, we would raise the number to 80,000 souls.

A MOSCOW correspondent of the *Financial News* says that Russian railway extension is going ahead with "gigantic strides." Two separate expeditions are now roughly surveying the two new lines projected in Siberia and Central Asia, and are said to be covering 20 miles per day. The Central Asian line will pass from the river Eelee, which is navigable, to Skatarinberg, where it will intercept the 28,000,000 lbs. of tea annually brought this way from China. Construction is promised on these early in 1889, as the surveys will not be finished until Dec. 1888.

THE *Novoe Vremya* says that the Russian Government is discussing the extension of an existing railway, coming from the direction of the sea of Azov, across the Caucasus mountains, to connect with the Batoum-Baku railway somewhere near Tiflis. The road would be about 111 miles long, with a tunnel 3 miles long, and would cost about $15,345,000. This would give Russia an all-rail communication between St. Petersburg and the Caspian Sea, and a more direct communication with the Caspian-Samarcand line.

THE Technical Commission, now sitting in Paris, are laying out an elaborate system of railways for Tonquin. The most important line runs from Hanoi to the coast at Haiphong, with branches southward to Hue and north to Laokoi on the borders of China.

ACCORDING to the Administration Report on the Railways of India for 1886-87, in the last official year, 1,014 miles of railway were added to the system, bringing up the total to 13,390 miles. The total capital expended on these roads has been $891,855,000 (about $66,606 per mile). The gross earnings for the last 12 months were $83,520,000, or $6,237 per mile. The working expenses represented 48 per cent. of the total revenue, leaving a handsome profit.

THE scheme for a metropolitan railway in Paris has been rejected by the Chamber of Deputies by a majority of 37. The subterranean feature is said to have been the cause thereof.

THE London, Brighton & South Coast Railway directors have just voted an honarium of £10 to an employé who rushed through the Betchworth tunnel, when the roof was falling, and stopped the Portsmouth express. That train must have been loaded with a very cheap lot of people.

THE *Railway News* says that Mr. JOHN JACKSON, an English contractor, has just signed papers with the Argentine Government for the construction of about 450 miles of railway. There are three lines: One north from Chilcas to Jufuy, 150 miles; one west from Chelectcito to Dean Fumes, 250 miles, and a branch road of 40 miles from Chumbicha to Catamarcus. The work is to be done in four years at a cost of about £2,250,000. All supplies will be of British manufacture.

THE Union Switch & Signal Co., of Pittsburg, Pa., is putting in a new system of interlocking switches in the freight yard of the Union Station of the Boston & Albany R. R., at Worcester, Mass.

THE recent strike on the Midland Railway, of England, brings out the fact that the highest wages paid to the Midland engine drivers, or locomotive engineers as we would call them, are $1.80 per day of 10 hours, or $10.80 per week of six working days. Employés of but 6 months standing receive only $1.32 per day; during the second 6 months their pay is increased by 1 shilling; and for the 4 succeeding years their pay does not exceed $1.68 per day. Firemen receive from 84 cts. to $1.08 per day. These rates are said to be very nearly uniform with those of the other principal roads of England. Compared with the $135 to $175 per month earned by the engineers of American passenger trains, and $60 to $120 of freight drivers, the English pay seems very small.

A CONVENTION is to be held on October 11, at Peoria, Ill., for the purpose of organizing a movement to build a ship canal from Lake Michigan to the Mississippi river. Congress is to be asked to build it. The Chicago delegates will approve of the scheme if the same canal can be utilized in the drainage of that city.

AN El Paso despatch denies the assertion, lately quoted by us from the N. Y. *Times*, that a vessel drawing 10 ft. of water passed from the Gulf into Lake Nicaragua. It says that three considerable rapids, the Toro, Machuca and Castillo, would absolutely prevent any vessel from passing up into the Lake. The same authority also further says that instead of a sailor seeing the Pacific from an elevation of 41 ft. above the deck of a vessel floating on Lake Nicaragua, he would have to ascend to a height of 400 ft. to overlook the intervening spur of the Sierra Madre Mountains.

The Density of the Earth.

Two new methods of determining the density of the earth are being experimented upon at Berlin. The one, by Dr. F. RICHARZ and Dr. A. KONIG, has been referred to in *Science* (v. 217). These gentlemen apply a sensitive balance with a double pair of scales, one swinging above, the other below, a heavy parallelopipedic mass of lead, which consists of a number of blocks which are exactly measured and weighed. The blocks are perforated, and the wires connecting the upper and lower scales pass through the shaft formed by these perforations. By an ingenious arrangement, the weights, which consists of spheres of lead, can be changed from the upper to the lower scales without opening the case in which the balance is enclosed. The principle on which the experiment is founded is, that, if one of two equal weights is below, the other above, the mass of lead, its attraction will diminish the weight of the former and increase that of the latter. The proportion between this increase and the total weight gives the means for determining the proportion between the attraction and masses of the lead and the earth.

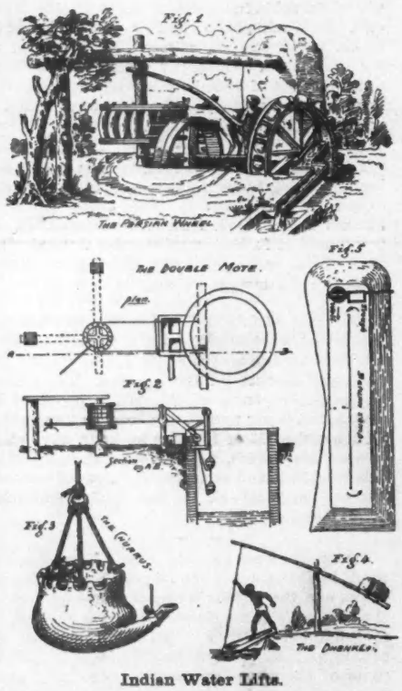
Preliminary experiments made with this balance show that a great exactness of the definite measurements may be expected. These experiments are being carried on under the auspices of the Berlin Academy of Sciences in a casemate at Spandau. At the same time J. WIBRING is experimenting by another method in the astrophysical observatory at Potsdam. He used a pendulum made of brass tube one metre in length and four centimetres in diameter, with spheres of cast iron weighing five hundred and fifty grams at the two ends. A knife-edge of agate six centimetres in length passes through the center of the tube, and swings on an agate rest. Two small mirrors are attached to the knife-edge, and the oscillations of the pendulum are observed through a telescope. The time of oscillation of the pendulum may be so nicely regulated that oscillations of five minutes length are perfectly regular. Near the iron spheres and opposite to one another, two iron cylinders weighing 325 kilograms are placed, the lower one attracting the lower end of the pendulum to one side, the upper one the upper end to the opposite side. The attraction of these masses affects the oscillations of the pendulum. The result of these observations for the mean density of the earth is 5.594 ± 0.032. The mean of former reliable observations being 5.57, the new figure corresponds well with these. Both experiments will result in a more accurate and trustworthy determination of the mass of the earth.—*Science.*

East Indian Water Lifts.

The appliances for raising water in India are interesting from their antiquity and as being typical of the slow-going and conservative ways of Eastern nations.

The apparatus used all over the country is that known as the *mote*, which in its simpler form consists of a species of leather bag, or *churrus* (Fig. 3) distended by an iron hoop, and hoisted from the well by a rope passing, over a wooden roller or a disc, to the yoke of a pair of bullocks. In the form of *churrus*, shown in the illustration, the discharge pipe is the skin of the neck of the animal furnishing the leather. This neck or spout is held by a separate string up alongside the rim of the vessel when it is being filled and hoisted, and is dropped by the driver when the contents are to be discharged.

The double *mote* (Fig. 2) is a modified form of the simpler arrangement, in which two bags are alternately raised by walking the bullocks driving the hoisting drum in one direction until the first bag is lifted, and then reversing them to bring up and empty the other bag and lower the first. Our



Indian Water Lifts.

readers must figure out the mechanical action for themselves, as they have all the illustration and description possessed by this journal.

In the *Lagor* system of lifting water, the cattle travel down an earthen ramp, at an angle of from 1 to 5, or even 1 to 20, and thus draw the bag to the top of the well over the usual roller. There is only one ramp or slope, and when the *churrus* is emptied, it is thrown back into the well, and the cattle leisurely walk up the slope. The *churrus* in this case sometimes weighs 500 lbs. when filled with water. In the *kili* system there are two ramps (Fig. 5) and the native driver sits on the rope going down the slope, and as soon as the water-bag is emptied he pulls out the peg (the *kili*) that fastens this rope to the oxen, and holding the end in his hands he allows the weight of the *churrus*, in descending into the well, to draw him up the incline. The oxen walk up a parallel way, attracted by a feed-trough put at the top. Three men are employed, one driving, one emptying the bag, and one at the water course. One pair of bullocks will empty from 80 to 90 bags per hour, depending of course on the depth of the well. In the Deccan the *churrus* sometimes contains from 6 to 8 cu. ft. of water, and four oxen are required to pull it up. A fair working example, however, is one of 3.5 cu. ft., and out of a well 47 ft. the water lifted in a working day of 8 hours amounts to 1,785 cu. ft.

The Persian wheel (Fig. 1) is one of the very oldest water-raising machines known. It is entirely made of wood and is huge and clumsy. As usually constructed, the drum is made of upright bars of wood between two framed discs which work a rude spur-wheel with projecting wooden teeth, which wheel turns the lifting wheel proper. This last has loosely fastened about it a belt or belts of cotton rope, to which small earther pots or tin buckets are attached in such manner that the contents are spilled over the rim of the wheel into a trough, when the full vessel reaches the top of the wheel. These *chatties*, or pots, usually hold about 40 lbs. of water, and Capt. CLIBBORN estimates that a large wheel with a "50 ft. lift" will raise 200 cu. ft. of water per hour, and as an actual example a wheel with a "40 ft. lift" raised 420 cu. ft. per hour.

The *dhenkli* (Fig. 4) is really the *shadoof* of ancient Egypt, and is used in lowlands for raising water to the surface. Its simplest form is shown in the illustration where a single post and a weighted sweep form the lifting device. The scoop for raising the water is a hollow wooden trough with an opening at the inner end, and it is filled by the native stepping on it as shown.

The other and last common method of water raising is by the *ratt* or *charki*, which is simply a light drum revolving over the well with a rope passing over it, which has an earthen pot attached to each end. The material for the above and the originals of the illustrations are taken from an abstract of a Report on Wells and Waterlifts, by Capt. CLIBBORN and others, and contained in the *Indian Engineer*. The original illustrations are not altogether satisfactory in showing what is intended, but we trust they will be understood.

Michigan Central Passenger Stations.

The Michigan Central Railroad has recently gone quite extensively into the reconstruction of its stations. Besides the three which we illustrate there is a new one nearly finished at Kalamazo, and various others have been erected from time to time in the last few years, although there are still many remaining which need reconstruction, as on most other roads.

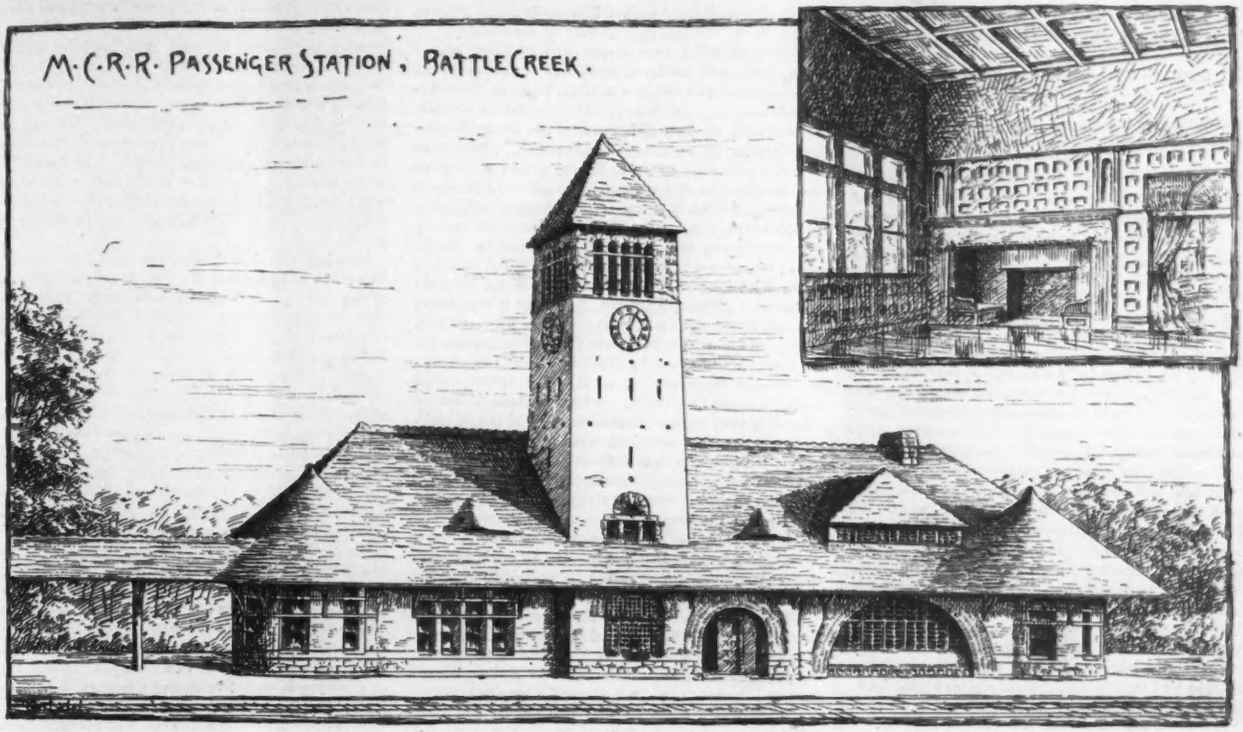
In a note transmitting the drawings, from which we have prepared our engravings, Mr. J. D. HAWKS, Chief Engineer, says:

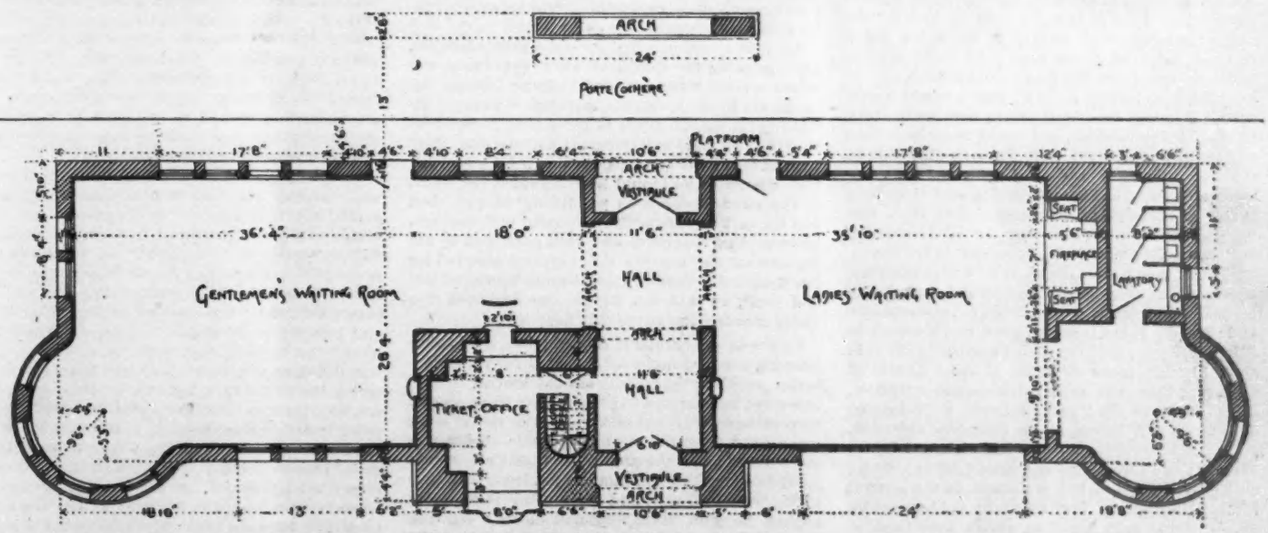
"The Ann Arbor station is so far the handsomest station in the State of Michigan, but I expect the one at Kalamazoo, now about finished, will look as well, and the one at Battle Creek will also be a very handsome building. The Ann Arbor station has been already illustrated in the *Railroad Gazette*."

We do not give architectural views of such buildings as these to encourage engineers in attempting to design them themselves, but as some will attempt it, it is well that they should have good examples before them, and even if they do not, that they should have some standards of comparison. The Battle Creek station especially, of which we give the larger view is a pleasing example of what fine effects can be produced by mere symmetry of form with an almost entire absence of architectural ornament. As such, we cannot but think it a greater success than the Ann Arbor station, although the latter is the larger. Mr. F. H. SPIER, of Detroit, is the architect of the latter and of the small Dexter station, and Messrs. ROGERS & MAC FARLANE, the architects of the former. Messrs. ADAMS & ROGERS, of Detroit, are the contractors for the Battle Creek station, and Messrs. J. L. GEARING & SONS for the Ann Arbor station, which is built entirely of dressed boulders, with slate main roof, red tile tower roof, and copper on the small tower.

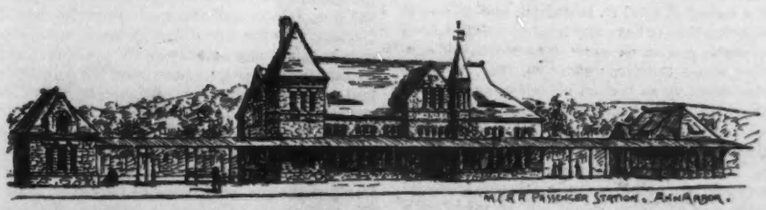
THE London *Architect* notes that the service of silver plate, valued at £2500, which was presented to Sir Humphrey Davy by the coal owners of the North in recognition of his invention of the miners safety lamp, and later willed to the Royal Society, was melted down in 1868. The Royal Society explains that they used the proceeds to produce the yearly Davy medal; but the *Architect* very properly thinks they might have obtained the funds more honorably than by destroying an object of art intended to record advancement in science.

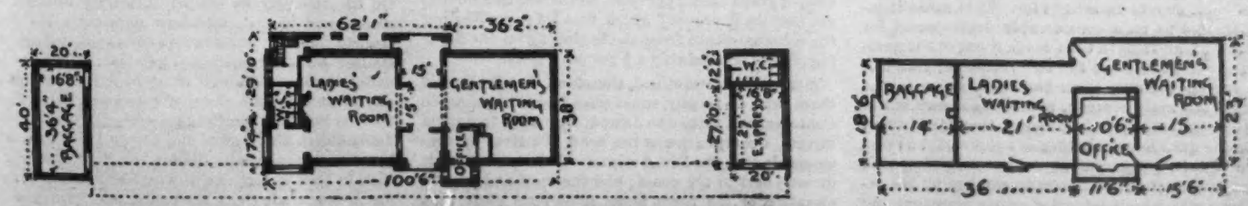
THE report of the locomotive department of the Chicago and Northwestern Railroad shows that the cost of running the locomotives of the company averaged 17.49 cents per mile, and that the average run to a ton of coal was 28½ miles.





Michigan Central Passenger Station.—Battle Creek.





Michigan Central Passenger Stations,—Ann Arbor and Dexter.

The American] Line from Vera Cruz to the City of Mexico, via Jalapa.

WITH NOTES ON THE BEST METHODS OF SURMOUNTING HIGH ELEVATIONS BY RAIL.

[A paper by A. M. WELLINGTON, M. AM. SOC. C. E. read before the American Society of Civil Engineers.]

(*Continued from page 166.*)

In March, 1881, the writer was engaged by the Mexican National Railway Co. to act as engineer in charge of location and surveys on the various lines for which they had concessions, extending from the City of Mexico to the United States and to the Pacific Coast. On landing at Vera Cruz, with a large staff, under orders to report in Mexico, he was surprised at the receipt of a letter of instruction to the effect that a corps were engaged in examining a line from Vera Cruz to Mexico *via* Jalapa, and that he should detach another corps for service on this line, sending forward the remaining parties by rail; that he should then make a reconaissance "sufficient to determine the general possibilities of the route, taking such escort as might seem necessary;" set the new and old parties at work; and not delay date of report in Mexico "more than six days."

To one landing in Mexico entirely ignorant of the language and the country; provided with no map or profile of the existing line, and knowing nothing more of its character than the general fact that it was one of the heaviest and most costly railways in the world; unaware that its engineers had even given a thought to a route *via* Jalapa, or even that there was such a place, until he finally learned that the route had been examined only to be abandoned, and that the branch which had been built to Jalapa, at the foot of the mountain proper, had 10 per cent. grades, and was practicable only by horse power; unaccustomed to a tropical climate and to the saddle; provided with no map of the region better or much larger than the map published last week which accompanies this paper; and innocent of all knowledge as to how large an escort would insure safety, if indeed any could—these were sufficiently formidable instructions, and could never have been successfully carried out, as fortunately they were to the letter (barring two days' delay from an unseasonable rain), had reconnoitering such lines been in fact so entirely lawless a matter that there was nothing for it but to look over the whole country and then decide what to do, or at least to try for.

The line which was found to be under examination is indicated by dotted lines on the general map herewith, and was at once rejected as impracticable and absurd. It ran from the coast northeasterly to Jalapa, 4,500 ft.; then descended southerly, 850 ft. in about 10 miles, to an elevation of about 3,650 ft. at Coatepec; then was expected to ascend somehow, some 7,000 ft. to the "pass" between the volcanoes of Orizaba and Perote, at an unknown elevation, estimated at 10,700 ft., in an air-line distance of some 15 miles; and then to descend some 2,000 or 3,000 ft., on the back slope of the mountain, to the general level of the plateau. Very naturally the best grades which it was even hoped to obtain were those of the Mexican Railway, or 4 per cent. uncompensated.

It was at once clear that either something considerably better than this must be obtained, or the line should be reported as impracticable and the whole staff withdrawn. And it seemed equally clear to the writer that either a considerably better gradient than on the existing line must be obtained, and lighter work as well, or the project reported as undeserving of any consideration financially. A reasonable hope for a maximum grade of not over 2½ per cent. at most was therefore fixed upon as the highest one justifying setting parties at work on it, and hence to be considered at all; and this, to make the project a meritorious one, required that 2 per cent. should be sought for. This made it indispensable to gain considerable development for the ascent, and this in turn made it out of the question to ascend between the two volcanoes, even had the saddle between them been cleft down to the level of the main plateau, which was known not to be the case. The whole problem therefore turned upon the question of whether or not it would be possible to turn northward at Jalapa (assuming that point to have been successfully reached by the required grade, which seemed a minor question) and run parallel with the coast line and the coast range, gradually ascending with all possible development, and turn the mountain of Perote to the north.

This possibility the writer was satisfied would turn, negatively at least, upon the simple question of whether or not there was some kind of an established highway ascending from Jalapa to the plateau, following in a general way the same course, and turning the mountain to the north. That is to say, the existence of an highway would not prove the line was practicable, but the absence of it would go far to prove that it was impracticable. In respect to highways, the writer had even then learned by sad experience, and had repeated occasions in the next three years to realize still more fully, that the route of an highway is ordinarily the worst possible guide for a locating engineer, except as it may serve the negative purpose of a danger sign to warn him away. He now recalls no less than twenty-three instances on the lines in Mexico under his charge where the existence of a traveled road proved merely a snare to deceive. Some of these instances were of a very curious character and of much technical interest, but description must be forborne.

But in regions of real difficulty, where the elevations to be surmounted become serious even for animal power, and even after all avoidable rise and fall has been eliminated, the case is different. The writer's experience and conviction is that in such cases the aggregate intelligence of the cows and the natives thereabout may safely be trusted to discover and utilize the very best route there is for surmounting the elevation with the least amount of work. Even what would be regarded in Mexico or Colorado as so simple a problem as that of making the 900 ft. rise over the Allegheny Mountains in Pennsylvania is a case in point. The pass above Altoona and Hollidaysburg was discovered and utilized in the very earliest days of the settlement of the country, and four generations of engineers on four successive public works have been able to do no better.

The first question asked by the writer, therefore, after learning the details of what was doing, was whether there was a traveled highway turning the mountain to the north, the map before him not extending far enough north to show that region distinctly at all. He was informed at once that there was, and a very old and good one. Had the response been otherwise, he should have regarded the result of the reconnaissance as practically decided then and there. The statement was coupled with another, however, that this route had been examined by the engineers of the Mexican Railway, and reported far less practicable than the line afterwards adopted and and built, so that the middle line described was under examination as the only hope left.

This was discouraging enough; but on further learning that the highway had been for three centuries preceding the railway era the leading one between the interior and the coast; that there was no succeeding descent, but rather a gentle rise in it for many miles after the mountain grade proper was surmounted; that the summit was (this afterwards proved an error) several hundred feet lower than that of Mexican Railway; and some other facts which seemed hopeful, there appeared to be a fighting chance, which was at least the only chance that the line might be developed to give the requisite grade.

The more immediate question became then to make the ascent of 4,500 ft. to Jalapa, and it was at once apparent that to have any hope of doing this on such favorable grades as were alone worthy of consideration under the circumstances, the line must be carried down to as low an elevation as possible, parallel with the coast and the mountain slope, by running south from Jalapa toward Coatepec before beginning to lose distance by turning eastward to the sea. It appeared probable that the 850 ft. of fall between these two points, as to which some definite knowledge was available, could not be made on a steeper grade than 2 per cent., and it was this fortunate fact [as it proved] which first led to conducting the reconnaissance from the beginning on the fighting chance of obtaining a 2 per cent. grade.

It was now determined, therefore, that the line, if there was to be any, must pass from Vera Cruz to Coatepec, and thence to Jalapa, instead of to Jalapa direct. Coatepec lies at the head of a river of considerable size, the Rio Antigua, which runs from it directly east to the coast; and the map and known elevation of the town made it at once clear that there was no physical impossibility in descending this valley directly on a 2½ per cent. grade, or perhaps less, if the valley had a tolerably uniform descent. It needed but the most moderate knowledge of the general laws of topography, however, to make it practically certain that no even approximately uniform descent could be hoped for in a river flowing in a deep gorge, cut through what was practically only a narrow footing to the most tremendous mountain slope on this continent. The foot-hills of a slope which reached a height of 17,873 ft. and started practically from the level of the sea, was certain to have, like all such slopes, a decidedly concave profile.

Nothing less than 5 per cent. could be rationally hoped for in following the bed or immediate slopes of the valley, and it therefore became quite certain that the line descending from Coatepec must start from the lowest point at the head-waters of the Rio Antigua which it was possible to obtain, but speedily rise up on the higher slopes of the valley and out of the influence of the stream, until at last—and probably, within a short distance—it would rise above all supporting ground. No resource would then remain but to turn across northwardly, at some favorable point on the dividing ridge, into the valley of the next river to the north, the Rio Chachalacas, with the view of gaining only such limited development as might be necessary to catch upon some high point on what were known to be the gentle slopes of the lower valley of that river, from which the line could descend eastwardly on the required grade to sea-level at a point as near to the coast as possible. The only fear in this process, besides the danger of heavy work, was that it might be unavoidable to make a long horse-shoe development up the valley of the Chachalacas, bringing the foot of the grade far inland from the sea, and causing just so much unnecessary loss of distance on a level before reaching the foot of the mountain grade. The existence of these two parallel and deep lying streams made it certain that the general scheme below Coatepec would be practicable, if not too costly; and the immense depth of the southerly valley, which varied from 1,000 to 2,000 ft., together with the absence of all supporting ground to the south of it, made it certain that the line could at no point turn south between Coatepec and the coast.

Thus, by a process of exclusion, the entire line was projected and sketched upon the map, with most dismal apprehensions of the character of the work which would be encountered, but with absolute confidence, expressed at the time to the gentlemen who accompanied the writer on reconnaissance, in the face of some opposition, that if this line was not practicable, there was nothing in the region which was sufficiently defensible, from an economic point of view, to make it even worth examination. The line shown on the general map (published last week) which the writer now has the honor to lay before the Society, does not differ by its own width at any point in the entire ascent of nearly 8,000 ft. to the plateau from that which the writer thus sketched upon the map in the City of Vera Cruz, and showed to several gentlemen, on the evening of the day when he first landed in Mexico; within two hours after first learning that there was such a place as Jalapa, or that there was, or ever had been, such a project as an ascent to the plateau through that region, and with the elevation of only two points on the line, Jalapa and Coatepec, approximately given. Neither does the line differ by much more than its own width at any point from the position of the line as finally surveyed, as shown on the detailed maps and profiles which are herewith laid before the Society complete, the more difficult upper half of the mountain grade only having been engraved on the topographical map and profile herewith.

The writer would not be understood to assert or imply that equal positiveness in defining in advance the limitations of reconnaissance is often possible. On the contrary, he has never known another instance just like it, although it became his duty later to consider projects for several other lines of a similar but less exacting character. But the peculiar conditions, it will be seen, left no escape at any point from the chain of reasoning. Had there been no existing parallel line, one might have justifiably taken the region for better for worse, and borne with equanimity finding it a great deal worse than he took it for. As it was, the fighting chance for a low grade was the only one economically worthy of attention, and this primary fact given,

FERRO CARRIL NACIONAL INTEROCEANICO.

From VERA CRUZ via JALAPA to the CITY of MEXICO and the PACIFIC COAST.

Profile of the PRELIMINARY LOCATED LINE on the

UPPER HALF of the MOUNTAIN GRADE

From JALAPA to LAS VEGAS.

Sections 7, 8 and 9.

A. M. WELLINGTON, Chief Engineer.
John S. ELLIOTT, Chief of Party, Secs. 7-9.

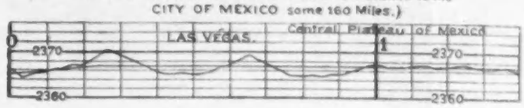
Levels are on Old Datum reading about 50,000 metres below true Elevation.

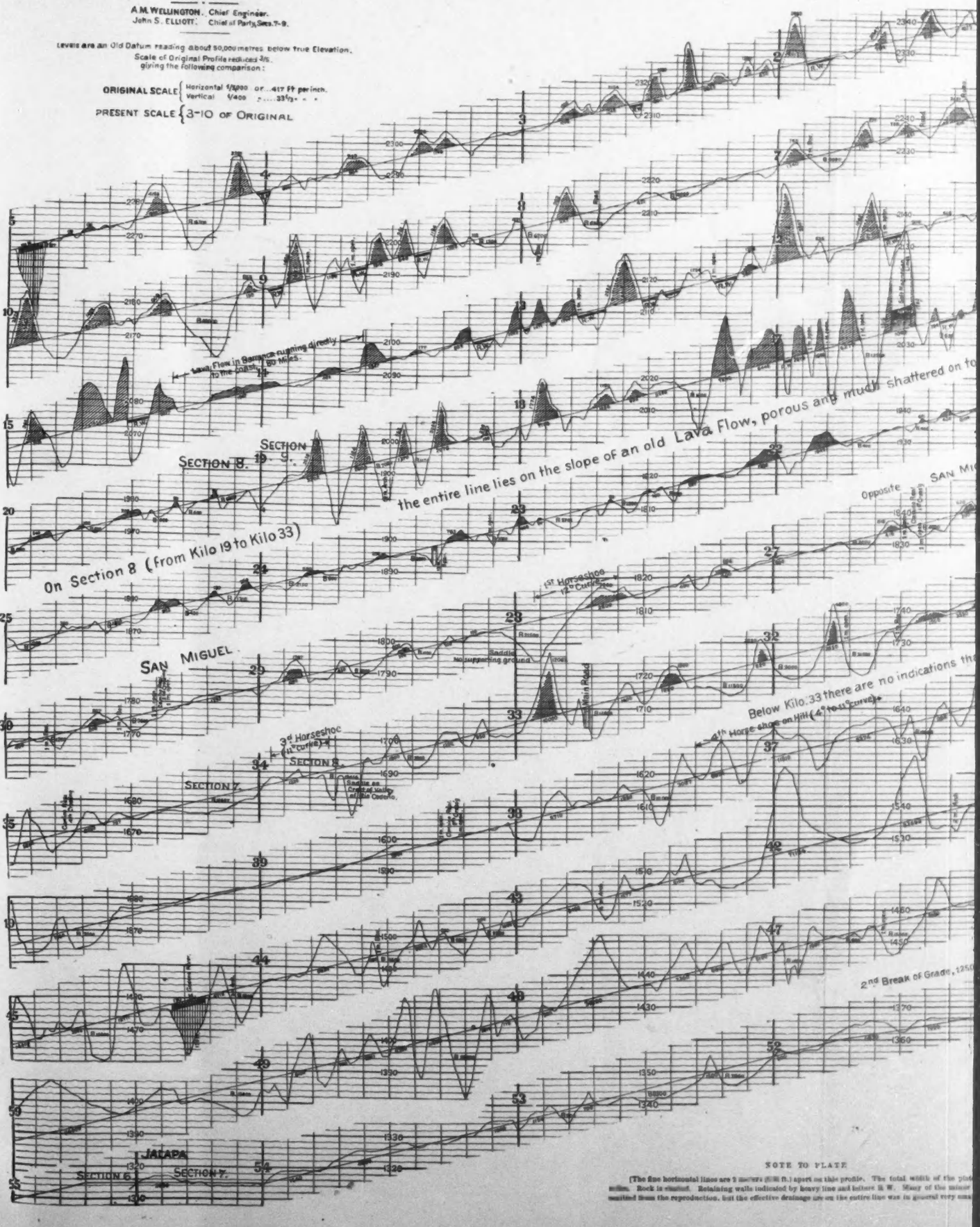
Scale of Original Profile reduced 3/5, giving the following comparison:

ORIGINAL SCALE { Horizontal 1/5000 or ...417 Ft per inch. Vertical 1/400 " ....33⅓ " " "

PRESENT SCALE { 3-10 OF ORIGINAL

PROFILE of PART OF FIRST MILE after reaching the SUMMIT.
(Line continues of this general character for the entire distance to the CITY OF MEXICO some 160 Miles.)

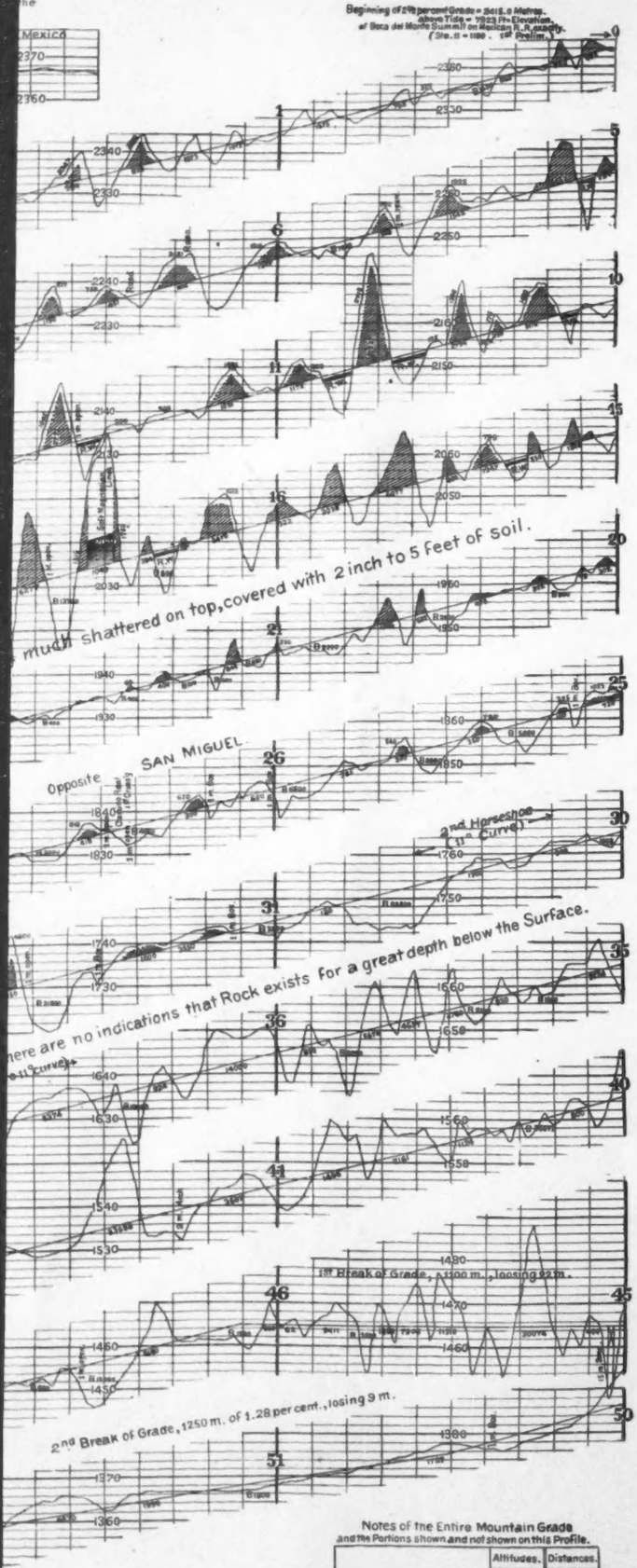



Lava Flow in Barranca running directly to the South 80 Miles.
SECTION 8.
SECTION 9.
the entire line lies on the slope of an old Lava Flow, porous and much shattered on to
On Section 8 (From Kilo 19 to Kilo 33)
Opposite SAN M
1st Horseshoe 12° Curve
SAN MIGUEL
Below Kilo. 33 there are no indications th
4th Horse shoe on Hill (4° to 5° curve)
3rd Horseshoe (5° Curve)
SECTION 8.
SECTION 7.
2nd Break of Grade, 125
JALAPA
SECTION 6.
SECTION 7.

NOTE TO PLATE

(The fine horizontal lines are 2 metres (6.56 ft.) apart on this profile. The total width of the plat
sation. Rock is stippled. Retaining walls indicated by heavy line and letters R. W. Many of the minor
omitted from the reproduction, but the effective drainage are on the entire line was in general very sma

MIT.
the



much shattered on top, covered with 2 inch to 5 feet of soil.

here are no indications that Rock exists for a great depth below the Surface.

LATE

this profile. The total width of the plate is 5 kilos., = 3.11
line and letters R W. Many of the minor culverts have been
on the entire line was in general very small.]

Notes of the Entire Mountain Grade and the Portions shown and not shown on this Profile.

	Altitudes.		Distances.	
	Metres.	Feet.	Kilos.	Miles.
Summit at Las Vegas	2415	7923	0	0
Jalapa	1,365	44784	5.43	33.64
Foot of 2 per cent.				
Grade, at Rinconada	183	6006	11.69	72.64
Totals, Whole Grade	2,232	7,323	116.9	72.64
Of which there is				
Shown on this Profile	1,050	34440	84.3	52.64
Not shown " "	1,182	38796	62.6	38.00

Lost by breaks of Grade, in the entire distance 106 metres (4.78 per cent of Fall) of which there was ...
On the portion shown 36 metres (3.43 per cent)
" " " not " 70 " (5.00 " ")
All of which and something more, it was expected to take up for compensation for curvature.

the conditions left no escape at any point from the train of reasoning that it was that one route or nothing.

The next morning at daybreak the reconnaisance began, and was pushed through with increasing confidence as fast as the animals could stand it, or at the rate of some 40 miles per day, the entire examination of the mountain grade occupying three days—such haste being merely in fulfillment of the writer's positive instructions, and naturally against his inclinations. Less time was required, however, because the only real purpose of the reconnaisance was not to find a route, but to examine on the ground the features of what was already known to be the only route affording a rational chance of success. The first 1,500 ft. of rise was seen to be on slopes smooth in detail, but sufficiently steep for laying down a surface line on almost any grade, and were not examined critically. The dividing ridge was then followed up, to judge of what was really the only critical point of the lower descent (from the point of view of possibility and not of cost), the passage from one water-shed to the other. A long and sharp spur ridge running eastwardly from Coatepec about half way to the coast, having a crest 5,000 or 6,000 ft. high, and standing at right angles to the main slope, was found to define the point where this passage must occur pretty definitely, and the material and topography was seen, with much relief, to be favorable for making this passage with as much or as little development as might be necessary, with considerable latitude in elevation and easy work. The south slope of this mountain, where the line would lie, was found to be almost impracticable for passage on horseback without camp equipage and time; but observing the north side to be fairly favorable, and taking it to be very unlikely that, in a ridge of this character, the topography would differ widely on the two slopes, it was passed by with a confidence that the result fully justified, as well as such very limited information as was available at the time. It will be seen from the maps and profiles of this section (not engraved) that on the surveys now submitted, a few of the most costly single works on the line are here, and not on the engraved section above Jalapa, which was really the critical section. This, however, the writer is, and was then, satisfied was due chiefly to the fact that the lower section, not being a source of much anxiety, was left in less competent hands. In part it was radically improved almost at the conclusion of surveys, and the writer feels no doubt that it all might have been more or less, although he makes no claim in that respect. Owing to the falling away of the country to the south, before referred to, and the existence of the deep *barranca*, or gorge, in which the river lay, which cut down almost to the sea level, or some 3,000 ft. below the line, some of the most sublime views of the line were on this section; but its difficulty was not in proportion, in part because of the very fact that the line lay so high as to be above the immediate influence of the *barranca*. The material on all this section was exceedingly favorable.

The region between Coatepec and Jalapa was known to be not very rugged, and to oppose no difficulty as to elevation, so that it also was passed by with a confidence which the result justified, and the project was complete to Jalapa, as a basis for surveys, with a reasonably favorable 2 per cent. grade line all but assured.

For the critical section above, the distance by highway was found to be almost one-half too short, and all hung upon the possibilities of development. The material and topography on the lower half was found to be favorable for this purpose, being earth to a great depth, as noted, and sufficiently broken up by ridges and hills. A long stretch at about the middle of the slope, near the village of San Marcos, was of an equally favorable character, being literally an inclined plane on a slope of about 1 in 10—an old lava flow overlaid with soil—and not much broken up in detail. The upper section was rugged, but short, with considerable opportunities for rather expensive development.

The whole of this region was examined on the third day of a very heavy rainstorm, the end of which could no longer be waited for, and the examination was necessarily restricted to salient features only. On a long grade line of this character, however, the possibilities of developing on practicable ground to reach certain elevations at certain fractional portions of the available distance, can be judged of with some certainty, the general character of the slope being the main feature; and the writer felt no real doubt then, or at any later time, that a grade in the neighborhood of 2 to 2½ per cent. was easily practicable, there being a certain considerable belt of favorable territory on which to place it, although above and below that the topography was much more forbidding. A leading factor in reaching this apparently hasty conclusion was the splendid and ancient highway already referred to, by far the best in Mexico, if not on this continent. It is a broad macadamized road with paved gutters, and a stone curb or masonry wall at the side, and the writer desires to pay a tribute of admiration and respect to the unknown engineer, whoever he was—very possibly one of the soldiers of Cortez, or one of his immediate successors—who laid it out. From a point near Jalapa to the summit, near Las Vegas, there is not a break in the steady ascent, and there are few points on it where a fresh team of horses would not readily break into a trot. The conclusion was natural, that if a Spanish soldier in 1530 could put something like a 6 per cent. highway down that mountain slope, an American engineer in 1881 ought to get a 2 per cent. railroad line down it, or take off his hat to his predecessor.

After reaching the summit, the continuation of the line to Mexico, or any other point on the plateau, was a detail offering no difficulties and needing no immediate study. The line was therefore reported on in writing to Mr. C. W. WETHERILL, Chief Engineer, three days later (March 28), as follows:

"The line under examination was too forbidding to be worth further attention. * * * I feel no doubt that the proper place for the line is to the north of Perote, and that something like a 2½ per cent. grade, or possibly a 2 per cent. grade, is practicable above Jalapa. Whatever grade is there obtained can certainly be continued down to sea-level and slope without excessive work. I have instructed surveys to be conducted above and below Jalapa on a 2 per cent. basis for the present, and consider the propects for a fairly favorable line good."

It should be mentioned further, that the writer's examination had been merely in a consulting capacity (the line not being formally a part of the Mexican National projects), and for some months later he had no permanent connection with or knowledge of the progress of the work, being absent on the Pacific slope. On being again asked to examine the line, Aug. 1, 1881, he found that his conclusions had been reported on as impracticable, and that a 3 per cent. compensated grade had been adopted, located in part, and was under construction.* Fortunately, however, a most intelligent assistant engineer, of great natural capacity for location, Mr. JOHN S. ELLIOTT, was in charge of the upper locating party. To his admirable conduct of surveys the success of this line was very largely due. Aided by information he had acquired, it was soon discovered that the abandonment of the 2 per cent. grade had been an over-hasty conclusion, from data which in fact assured its success. The work in progress was therefore stopped by the writer's advice; some $30,000 of completed work abandoned, chiefly in the approaches to a costly tunnel in earth; and the writer appointed chief engineer, continuing in charge until some time after the completion of the surveys now laid before the Society, when the abandonment of all furtherance of the project by the Mexican National Railway compelled his resignation, and shortly afterward led to the stoppage of all work. But for the fact that he was favored with an unusually competent assistant in immediate charge of surveys on the more difficult section, the writer fears that he should never have been able to carry through the line with the limited time at his command.

Two features on the upper ascent are worthy of special note: One, the great lava flow shown on the topographical map and before referred to, and the other, a still grander feature, the *barranca* of Zimilahuacan, a vast sink-hole in the earth some 2 or 3 miles in diameter, and some 3000 ft. deep by the barometer, about half of it sheer, with no transition, or "ragged edge" whatever from the surrounding surface of the plateau, which was as smooth and treeless as an Illinois rolling prairie but sloping about 1 in 12 or 15 in the chasm. This feature was encountered some miles beyond where all difficulties had ceased at the summit, and so smooth was the edge that the line skirted it with a mere surface line, so, near to it that a stone thrown from the car window would fall sheer full 1,000 ft. before touching. On the plateau the locality was so cold and so much exposed that it was stated that wheat would hardly head, while immediately beneath one's feet bananas, coffee, oranges and every form of tropical vegetation could be seen growing luxuriantly. A few miles beyond was a large and very ancient fortress still in good repair, but unoccupied, which would cost perhaps $5,000,000 or $6,000,000 to duplicate, in which for two centuries the great bulk of the silver product of Mexico was stored pending the arrival of transports at Vera Cruz. Several of the old line of visual telegraph towers which were used to communicate between the two points are still pointed out, although out of use more than a century. From several points on the upper ascent the City of Vera Cruz, 80 miles off in an air-line and 6,000 to 8,000 ft. below, is visible in clear weather. These and other features make the region one of the highest interest to the tourist.

TO BE CONTINUED.

*The concessions permitted of no delay in beginning construction.

Natural Gas, its Occurrence and Application in Pittsburg.*

[A Lecture before the North German Iron & Steel Association at Osnabrück, Germany, by KURT SORGE, M. E., Translated by J. H STELLMAN.]

As a German engineer, on a visit of study to the United States, my first impulse was to investigate the wonderful achievements of American iron industries, the remarkable results of which, though known to us, we were justified in doubting, as, we were not able to form an adequate idea of the means employed.

I found, that independent of the recognized mechanical talent, inventive genius and untiring energy of the American people, there existed two predominant causes—these are: the immense ready capital, apparently always at their disposal, and the remarkable natural richness of the soil.

I have personally gained the conviction, that capital, in the United States, can always be raised for any enterprise, of probable success, even with slight security; and while we acknowledge their capitalists as *far more* enterprising than ours, this fact may in a measure be explained by the several predominant causes above given: and by the remarkable natural richness of soil, as a possible loss is easier to recover and therefore easier to endure.

I beg, gentlemen, now to call your attention, for a brief period, to a natural product of the United States, which in itself is an important factor in the success of American iron industries, of which you have all heard, but of the mighty potency of which you cannot form, if I judge from the measure accounts given in German periodicals, even an approximate conception,—I mean the gassy outpourings from the bowels of the earth, which have received the general appellation of "Natural Gas."

Pittsburg, Pennsylvania, which has already been bountifully favored by nature is, though not exclusively, that manufacturing center which has derived the greatest benefit from this powerful natural fuel. A brief description of this city will not be here amiss. In 1880, Pittsburg had a population of 156,000, and Allegheny, her sister city numbered 79,000; the population has increased so rapidly since, that it is now estimated at 300,000. Situated in the center of a rich coal valley, at the confluence of two rivers, Allegheny and the Monongahela, here jointly forming the Ohio river, which in turn develops into a powerful tributary of the Mississippi, Pittsburg combines with a situation of landscapic beauty, everything which serves to make it a manufacturing center of the first class. The Allegheny river is naturally navigable, and the Monongahela is made so by a system of locks, aided by a powerful dam and lock, drawn square through the Ohio river at a point below the city. Twelve different railroad lines enter Pittsburg and Allegheny, and facilitate the shipping of its products to all parts of the country, at low rates of freight, and the receiving of iron ore from Lake Superior, etc. It would lead me entirely too far, were I to even touch upon the multiplicity of existing manufacturing interests; may it suffice, when I state, that the total value of Pittsburg's products in 1884 was $181,000,000, and that 75,000 workmen were employed in 9,583 different industrial establishments. The largest proportion of this is credited to the following: the iron works inclusive of machine shops, 50 per cent.; the collieries, 10 per cent., and the glass works, 4 per cent. the remaining 36 per cent. being distributed among various other industries. The best view of Pittsburg and its industrial surroundings can be had from the

top of the hills, which flank the rivers, and which can be conveniently reached from the river-side by incline planes, either by pedestrians, or equipages and teams.

The observer on reaching the top, views the city at his feet, and is both attracted by its picturesque beauty, and surprised at the sight of the innumerable factories which meet his gaze. Five bridges span the Monongahela, while nine link Pittsburg and Allegheny, over the Allegheny river. From the south side, "Duquesne Heights," the eye can penetrate for miles upwards into the valleys of the rivers forming the Ohio, as also down into the beautiful valley of the river itself. The grandeur of this panorama is only equaled by the feeling of interest awakened in one at the sight of the six river shores, closely studded with factories, mills and works of every conceivable kind; also with wharves for the active river traffic.

As far as the eye reaches not a solitary spot can be found, free from the occupancy of some industrial work or another; and nowhere else was the fact more clearly illustrated to my mind, that the bustle, excitement and activity, peculiar to American life, can only allot an infinitesimal proportion of time to the so justifiable enjoyment of life's pleasures. The immense number of chimneys and smoke stacks seen from this elevation, render an easy explanation of Pittsburg's cognomen "Smoky City," although the transparency of the atmosphere is much less infringed upon than would be supposed from the number of smoke-stacks. The foreign engineer is involuntarily possessed of a feeling of awe, nay of shame, at perceiving this apparently perfect system of heating and combustion; for it is a fact that, while the works inside are undoubtedly in full blast, only very small quantities of smoke are emitted from above. He, however, soon learns that this seeming phenomenon is not caused by any technical perfection in the system of heating, but by the ideal perfection of the fuel used; for in most of the factories which the observer views at his feet, natural gas is being used; and to this circumstance alone is attributable the freedom from smoke and the clearness of the atmosphere. I have been assured, that prior to the introduction of natural gas, the sun was often invisible for days in Pittsburg, while only a few miles away, over the adjacent hills, it would be shining in all its glory.

It is well known that the occurrence of natural gas is by no means of recent date; its novelty in Pittsburg consists in its potency, its extensive application and its multifarious utility. In briefly touching upon the historical part of the question, I lay aside the occurrence of natural gas among the ancients, the most important of their time being probably "The Holy Fires of Baku," and will merely state that low pressure gas springs have been found in Germany, one of which, at the salt works, Gottesgabe, on the Rhine, was, to my personal knowledge, utilized for illuminating purposes. In that district of the United States, where the question is one of heating and combustion, gas wells were known to the earliest settlers, and have been in economic use since 1821. The little town of Fredonia, N. Y., is justly entitled to the honor of having first ascertained the practical value of this emanation from the earth, and of applying it to lighting purposes in the year named. It is true, only the modest number of thirty burners were in use, which number was only increased, when owing to the growth of the town, they were not sufficient; and a second well was drilled in 1858, which furnished the supply necessary for two hundred burners.

While drilling for oil in Western Pennsylvania, in the year 1859, it was found that small quantities of gas were always associated with the oil, and *vice versa* gas wells were occasionally struck, which contained traces of petroleum; these latter were soon brought into use for heating boilers, which furnished the power for oil pumps and derricks, but had no further application for many years; although an eminent American chemist, Prof. WURTZ, pointed out the importance of the occurrence of natural gas and its great fuel value, seventeen years ago. In the search for oil several very powerful gas wells were discovered in the vicinity of Pittsburg; among others, as early as '78, one was struck in Murraysville, at 400 ft. depth, which was so powerful as to throw out the tools and drilling implements, completely ruining them as well as the derrick. But even this well remained unutilized for many years; it was lighted and formed an immense column of fire, which illuminated the surrounding country for miles at night, and created great excitement. During many years invaluable quantities of this costly fuel were thus wasted, until 1883, pipe lines were laid for the purpose of conducting the gas to proper places for economic use. As inexplicable as this waste must appear, when we consider the practical turn of mind of the American people for which they are so justly noted, and the great advantages already derived from natural gas, we must also take into consideration that its permanent flow was, and is still, very uncertain; that it requires heavy outlay of capital in its utilization; and that a very cheap fuel was then to be had in coke, which cost only ninety cents per ton at that time. Under these advantageous conditions, it is pardonable that gas wells, the continued flow of which was uncertain, were neglected for a long time. In 1883, a company was formed, which brought the powerful well at Murraysville into economic use by laying a pipe line to Pittsburg; and in 1884 the celebrated Westinghouse well was struck within Pittsburg's limits; thence dates the practical application of natural gas to manufacturing and domestic purposes.

The chemical composition of natural gas is very variable; it will vary, not only in different wells, but will do so continually in one and the same well. The principal component part is marsh gas, and, according to Mr. FORD, chief chemist of the Edgar Thompson Steel Works, we give the following mean analysis, which was taken from six different ones, by Mr. FORD:

	Per cent.
Marsh gas, C_2H_4	67
Hydrogen, H	22
Nitrogen, N	3
Ethylic hydride, C_2H_6	5
Olefiant gas, C_2H_4	1
Carbonic oxide, C_2O_2	0.6
Carbonous oxide, C. O	0.6

Taking air as = 1, the specific gravity of gas will be 0.497.

From another authority we received the following limits:

	Per cent.
Marsh gas, C_2H_4	60 to 80
Hydrogen, H	5 to 20
Nitrogen, N	1 to 12
Ethylic hydride, C_2H_6	1 to 8
Propane, C_3H_8	0 to 2
Carbonic oxide, C_2O_2	0.3 to 2
Carbonous oxide, C. O	traces.

Gas from the same well was found by Mr. FORD to vary in the pipe lines of the Edgar Thompson Works, on different days, as follows, viz.:

	Per cent.
Nitrogen, N	0 to 23
Carbonic oxide, C_2O_2	0 to 2
Oxygen, O	0 to 4

From still another source greater differences appear in one and same well on different days, viz.: 35 to 40 per cent. and 70 to 80 per cent. On comparing the mean analysis of Mr. FORD with the mean one obtained by the "German Continental Society," from illuminating gas produced from Westphalia gas coal, we find the following interesting coincidence:

	Per cent.
Specific gravity	0.45
Marsh gas, C_2H_4	59 5
Hydrogen, H	30.9
Olefiant gas, C_2H_4	5.7
Carbonous oxide, C. O	3.5
Carbonic oxide, C_2O_2	0.4

The difference between both gases, apart from the carbonous oxide proportion, seems to be principally in the natural gas having more light carburated hydrogen to a lesser proportion of hydrogen; taking into consideration that the chemical composition of natural gas and artificial gas are equally variable, the coincidence becomes so much stronger; another not unimportant difference lies in the fact that the heavy carburated particles of hydrogen contained in artificial gas, have better illuminating qualities than those of natural gas, of which these qualities are merely nominal. The hydro-carbons in natural gas, like that of petroleum are of the Paraffine Series, and the geological origin of gas and oil are therefore closely related. In nearly all flowing petroleum wells—such as flow unaided by the pump—the pressure, which produces this apparently automatic flow, results from gas, contained in the petroliferous rocks, through which the oil flows, and which may either be in close proximity or at a great depth. In the first instance, gas is frequently associated with the oil as it pours out in intervals, and the gas current will not be interrupted, if the oil supply temporarily ceases. In the second instance no traces of gas are visible, although according to Ashburner, all oil from the wells of Pennsylvania and New York, contains traces of gas. A further proof of the joint origin of gas and oil is furnished in the circumstance that so-called dry gas wells, such as are supposed to be nominally free from oil, will, when placed under high pressure, show traces of oil and water. It is generally accepted, that natural gas and oil originate from the decomposition of animal and vegetable organic matter.

The entire territory of the great Appalachian coal bed, which bounds the western incline of the Alleghenies and spreads over a large portion of Eastern North America, during the Devonian period formed a vast lake, and later on developed into a multitude of smaller lakes and swamps; and the coal deposits, as also the gas and oil partitions furnish us proof of a luxurious carboniferous vegetation. During the Devonian period, alternate uplifts and slidings of the soil probably caused the various alluvial and vegetable deposits. The uppermost formation of this period represents the upper coal measures, and the decomposed vegetable and organic matter in the deepest strata are supposed to produce natural gas and oil. The gas producing rock is usually found at a depth of 1,000 to 3,000 ft. or at a much greater depth than the Pittsburg coal beds; and gas is sometimes contained in pockets or caverns, though not so frequently, or in a conglomerate of sandstone, which has absorbed it. It is generally believed that gas sand-stone, which in a geological sense is identical with oil sand-stone, only serves as a repository or bed for both substances, and that a formation of hydro-carbons is developed in the strata under-lying it. Gas and oil, having a joint origin, will often rise up together unseparated through the rocky strata, until they are checked by an impenetrable roof of rock, and thus, so to speak, collected into a receptacle or reservoir. The gas contents of a gas-rock therefore, greatly depend on the extent of the fissures or cracks in the rocky strata, both between the zones of vegetable and animal decomposed strata, and the gas-sand, as also between the latter and the surface of the earth, so as to determine the chances gas may have had for escaping. For, if the condition of the lower measures is important for the supply of gas, the condition of the uppermost is decisive as to the retention and collection of the same; if the latter are fractured or burst, gas will escape into the air; and in fact the absence of oil and gas in the Eastern States is attributable to the fractured condition of the rocks, as geological investigation shows the sand-stone there to be identically the same as that of the gas and oil regions.

The five most important conditions for the occurrence of natural gas according to the observations of the eminent American geologist, ASHBURNER, are, viz.

1. The porosity and homogeneousness of the sand-stone serving as repository.
2. The extent of the fractures in the lower and upper rock strata,
3. The caving in of the gas-sand strata.
4. The proportion of oil, gas and water contained in the gas-sand.
5. The pressure under which the gas exists.

As regards the pressure of gas at the wells, this will vary from 150 to 500 lbs. per sq. in. per minute in most wells, but in some instances 600 to 700 lbs. per. sq. in. per minute has been reached. A palpable proof of the high pressure under which gas exists, is furnished by the low temperature of the escaping gas, which will produce a coating of ice on the surface of the pipes on the hottest day in summer. Without entering further into the geology of natural gas, I will briefly allude to the so-called anticlinal theory, as the same has awakened very great expectations as to locating gas with a degree of certainty. The rocks of the oil and gas regions are known to form wide, though unimportant slopes and furrows of the synclinal and anticlinal forms of deposit, which with slight south westerly variations generally run in parallel lines to the Allegheny mountains.

According to well-known physical principles, a very just conclusion is therefore reached, when we suppose that gas rising to the highest points, will most likely be found along the anticlinal axis. In fact, this theory was built upon for a long time with great certainty; and not until experience proved that many wells drilled on well known anticlinal lines, showed little or no gas, whereas powerful wells were frequently struck in the undulations of the valleys, was the conclusion reached that the levelling inclination of gas-sand strata, the high pressure of gas, and above all the variability of the penetrable and impenetrable rocky strata, which act independently of the form of deposit, were of deciding influence, and liable to upset the accepted theories. This does not, however, prevent the anticlinal theory, when other important conditions are also observed, from being of great service in locating gas wells.

The geographical territory of the occurrence of gas wells seems to be an extremely extended one, as particularly in the last month, hardly a week has elapsed in which new gas wells were not discovered in the most widely separated States of the Union. The neighborhood of Pittsburg, however, up to the present date at least, seems to be the most prolific in this respect. In a radius of about twenty miles, with Pittsburg as a center, are four important gas fields, which are named after the towns of Murraysville, Canonsburg, Butler and Tarentum; each of these is of great importance in itself, and particularly at night with their innumerable derricks and burning gas wells, present a remarkable sight and one seldom seen elsewhere.

The process of drilling, as also the manner of piping, I was enabled to get a clearer insight into, in the Canonsburg gas field, through the kindness of the principal owner of an iron mill, and the first is as simple as possible. After erecting a derrick about 70 ft. high, wrought-iron pipes are driven through the soft ground until rock bottom is struck, generally at 60 to 90 ft. depth; then a drilling tool of about 2,000 to 3,000 lbs., attached to a rope, is brought into requisition, with a fall of 3½ to 5 ft.; the boiler is heated by natural gas, piped by a one-inch tube line from a neighboring well.

On drilling an 8-in. hole of 450 ft. depth, a 5½ in. casing is inserted to shut off water, and drilling is resumed until gas is reached, when another casing 4¼ in. in diameter is run in. A well is usually drilled down to the gas-producing rock in 40 to 60 days, and will cost from $1.50 to $2.00 per foot, according to the penetra-

bility of the rock drilled; 7½ to 9 ft. can be drilled in solid rock per twenty-four hours, as against 90 ft. in slate or shale ground.

The Edgar gas well in Canonsburg, which belongs to the Manufacturers' Natural Gas Co., was struck at a depth of 1,950 ft., and cost about $4,000, which will correspond to $2.00 per ft.

The potency of this gas well is clearly shown when lighted, as it burns with such force and impetuosity as to form a column of fire 90 ft. high.

During my visit last summer, they were just commencing to lay pipes from that point to Pittsburg, about eighteen miles distant, and the gas, though not burning, was pouring out into the atmosphere uninterruptedly; a few weeks before lightning had struck the derrick and set it on fire, as well as the current of gas which had just been reached; the heat, which was developed by the 90 ft. high flame, which issued directly from the casing in the well, was so intense as to prevent the work necessary for piping until the flame had been extinguished; this was accomplished after many vain efforts, and only owing to the fact that the gas-currents in these wells pour out under such high pressure as not to ignite until about 3 ft., above the escape pipe. An iron smoke stack was accordingly moved up sideways between the vent hole and the point of combustion, (see Fig. 2,) and thus cutting off

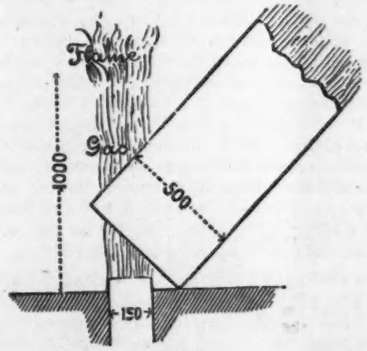


Fig. 2.

Cut 1 represented a view of Pittsburg, and was not included in this edition. The dimensions on the cuts are given in millimetres, which are equal to about $\frac{1}{25}$ of an inch.]

the supply from the flame, the same was extinguished. At the time of my visit, gas was piped by a 60 ft. line of 5½ in. pipe to a wrought-iron boiler, (provided with a manometer,) from which the gas escaped through a 20 ft. horizontal escape pipe of the same diameter. The boiler serves for the purpose of collecting the salt water and heavy hydro carbons carried along by gas and settling them into a saponaceous mass. The mano-

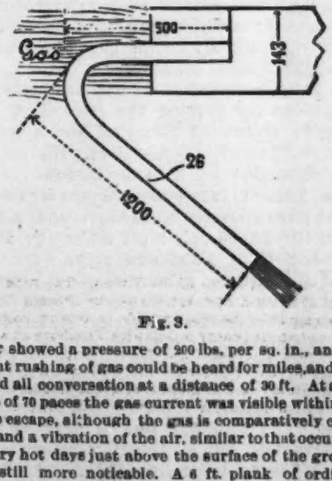


Fig. 3.

meter showed a pressure of 200 lbs. per sq. in., and the violent rushing of gas could be heard for miles, and prevented all conversation at a distance of 30 ft. At a distance of 70 paces the gas current was visible within 5 ft. of the escape, although the gas is comparatively colorless, and a vibration of the air, similar to that occurring on very hot days just above the surface of the ground, was still more noticeable. A 6 ft. plank of ordinary thickness, was carried 30 ft., off by the gas current, and 4 to 6 lb. stones were carried away about the same distance on our placing them in front of the escape pipe

I endeavored to hold a piece of one-inch bent tubing, which I accidently found, (in the manner illustrated by Fig. 3,) in order to switch off a portion of the gas, but I only succeeded after the greatest exertion in introducing the small tube into the pipe, and even with the pressure of my whole hand it was difficult to shut off the small stream thus turned off. I have found fit to describe these separate observations thus accurately, as, according to my opinion, they convey the clearest idea of the powers of these gas currents.

Another equally interesting well, the Conner's well belonging to the same company, and at a short distance was inspected by us on the same day. Gas had also been struck here at about 1,800 ft. depth, in considerable quantities, but it was concluded from various indications, that on drilling deeper, oil would be obtained;

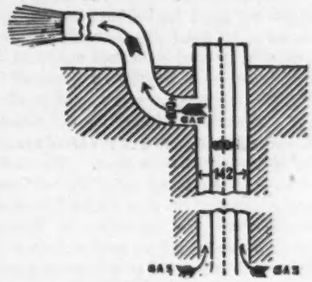


Fig. 4.

and as oil wells are much more valuable than gas wells, drilling was continued. The pressure of the outpouring gas soon became so strong as to necessitate the insertion of a 4¼ in. casing into the original 5½ in. casing thus shutting off the gas in the ring thereby formed. (Fig. 4.) A connection was then made with the main casing just below the derrick floor, and the gas piped about 100 ft. off and lighted, forming an immense column; drilling was then resumed in the narrow casing, from which only small quantities of gas now escaped. On the day of my visit, however, at a depth of 1,960 ft. the quantity of gas escaping had largely increased, and at the same time vaporings impregnated with the characteristic petroleum odor, were emitted, so that it was expected to strike oil at any moment, and as during the very time to which we had, for this reason, prolonged our visit, a perceptible increase of gas flow occurred, the excitement with which the driller as well as the owner, and finally we ourselves, were seized, gave us a slight idea of the oil and gas fever which affects the interested parties in such cases. About a week later an oil stream was struck, which rose to the height of the derrick, about 70 ft. and so continued at intervals for several days; but this oil flow soon subsided and finally settled down to about five barrels per day. The cause of these spasmodic spoutings was the accumulation of gas under the oil, until a pressure sufficient had collected to shoot the oil out, after which the accumulation of gas would proceed until a sufficiency of pressure was again accumulated to renew this shooting. A drastic means, called torpedoing, was then resorted to for freeing the presumably stopped-up well; a tin can containing 90 lbs. of dynamite was let down and exploded at a depth of about 1,900 ft.; the effect, however, was not as expected: instead of more oil, a mighty gas current was developed, and it was then decided to shut off the oil by driving two pine plugs, 4½ in. in width by 3 ft. in length, into the bottom, one on top of the other; and to obtain gas from above, that is at about 1,800 ft. depth.

Drilling is mostly done by contract, and the driller is supposed to find all his own tools and necessary appliances. Owners of property in which wells have been located, are always interested in a certain proportion of the profits, say to the extent of one-eighth; often, however, this interest is bought for a specified sum, and they are paid say $400 to $800 annually for each well producing paying quantities of gas.

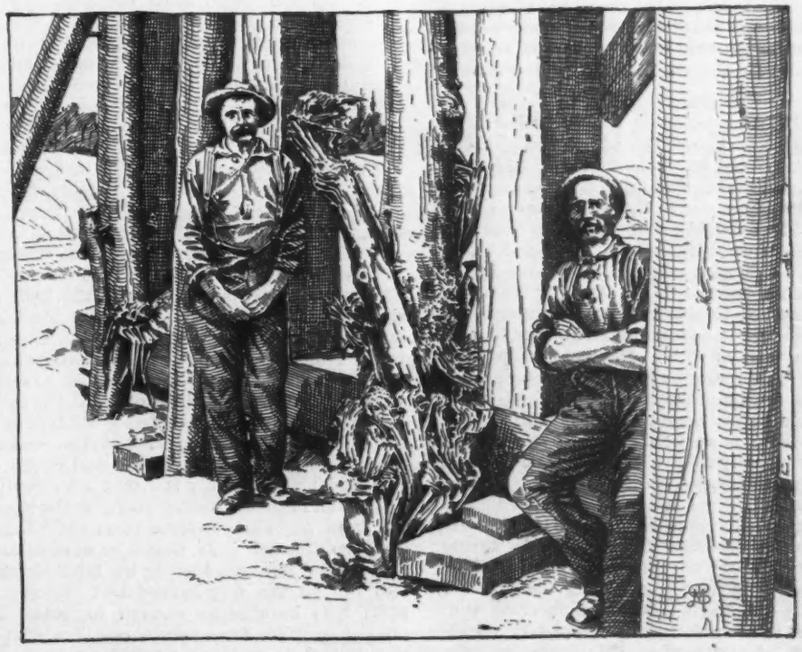
The lessee has the privilege of drilling as many wells as he may elect on the leased property, and also of utilizing them for a certain period: as a matter of course, both sides try to protect their interests to their best ability.

(TO BE CONTINUED).

A Center-Shot.

The original photograph from which the illustration herewith given was taken was brought to us by an amateur, who caught it as a curiosity simply. Consequently we are not quite as well posted in all the circumstances of the case as might be desired.

According to our information, the incident happened on the canal now being dug to connect Peconic bay with Shinnecock bay, at Conoe Place, Long Island. At the point represented a bridge



A Center-Shot.

for the Long Island Railroad was to be built across the canal, and piles were driven for the false works before the sand was removed.

In driving these piles it seems that they struck two other piles, or parts of piles, already sunk below the surface of the unexcavated ground, and with the result shown in our illustration. The fact that the ancient pile was well braced on all sides by sand, at the time it was centered by the new one, will perhaps account for the very thorough shattering it has undergone. Just under what circumstances the smaller pile to the left was damaged we are unable to say. The line of piles shown was intended to carry the railroad until the canal was excavated, and the more permanent timberwork there seen was put in place to await the construction of an iron plate-girder bridge since built. The photograph was taken in the summer of 1886, during a temporary suspension of work on the canal.

FROM his exhaustive experiments on the strength of wood from conifers, Professor Bauschinger concludes that the maximum crushing resistance is attained by this variety of timber in one year after felling. It further appears that the amount of moisture contained in the wood has a marked influence on both its density and crushing strength, which qualities, according to the professor, form the best basis for estimating the value of the timber.

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EDITORS.

GEO. H. FROST, - - - BUSINESS MANAGER.

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A CORRESPONDENT writes us: "Will you kindly inform me of the books required to gain a complete knowledge of mechanical engineering," and we would that we could answer him, but that is a thing which does not exist in this office, nor in any other that we know of, and we should consider it cheap if we could purchase it with several thousand dollars worth of books. One of the books he will certainly need is D. K. CLARK'S "Manual for Mechanical Engineers," but according to the degree of his advancement he may have to begin with anything from a spelling book down, and where he will end we cannot even guess, except that he will not end in the complete knowledge he wishes. This instance may serve as an illustration of the fact that we frequently receive large-sized enquiries of this nature, which the 2 cent stamp enclosed will hardly carry a reply to, and which are much more likely to be answered if the inquiry be made specific. There is this further difficulty about advising as to books relating to any branch of engineering that there is hardly any single kind of engineering work which in adequately and completely treated in one or two books. The available information is scattered through many volumes, good, bad and indifferent, which makes a choice very difficult even for oneself, and still more for another. The best and safest rule is "Buy everything; read most that which is good."

THE rate of immigration, we are pleased to note is falling off. In the month of July it was:

	1886	1887	Increase.
July	31,348	39,080	24.7 per cent.
Seven mos. ending July	221,313	325,531	47.1 " "

This is not going to be a banner year for immigration, although it will be very large, and nothing is more curious than to note the very sudden change of sentiment which has caused this fact to be hailed with almost universal satisfaction. The great American swallowing act has gone on heretofore with universal applause and satisfaction, but the whole country has suddenly wakened up to the fact that this tremendous demand on our digestive process is the cause of nearly all our political troubles, and of a large part of our industrial trouble as well. If we could but wholly stop the influx of foreign common labor for a decade or two, our material development might be somewhat less rapid, but it would be vastly more healthy, and our social and political institutions would be saved from a strain without parallel in the history of mankind, of which the general feeling is that we have had about enough. To bring about any kind of a change in such matters the first and greatest step, in this country at least, is to awaken a general feeling that a change is necessary. That accomplished, it has often happened that the change has followed quickly, and we should not be surprised if it did in this case. Nor do we even feel sure that a total stoppage of foreign immigration (except of the trained and educated classes, who are not likely to be interfered with) would result in any serious check to the construction even of public works, which require so much common labor for carrying them out;—and if it did, it would be but a slight and temporary loss for a great and permanent gain.

The fact is, it has become too cheap and too easy to emigrate to this country for our own good. In old days, from the days of the Pilgrims until now, while emigration was a serious matter to think of, natural selection had been picking out for us all the more enterprizing and determined and self-reliant from the best breeding stocks in Europe and no other stock came to us. Thus, it has been acutely suggested by ARTHUR HELPS, we were but repeating on a gigantic scale and under much healthier conditions the process which made the original greatness of the English race, which could not fail to tell, and has told on the character of our people. But within the last decade or two all this has changed. The poorer breeds of men, and the poorer stock of the better breeds, have been pouring in on us in great numbers. The quickest and surest remedy would be to restore something of the old conditions by taxing all foreigners an even $100 for the privilege of coming to this country and settling, returnable without interest if they left us again within *n* years. This would keep out the paupers and pauperoids, and bring us only the men who really had "stuff in them," but we fear it is hopeless to expect any such wisdom from our "beggarly politicians." It would be almost an ideally wise measure, leaving the latch-string still out to the fore-handed and energetic poor, who have sense enough to make a present sacrifice for a future gain, but shutting it fast against the worthless hordes of shiftless and lazy ne'er-do-wells, who for the first time in our history constitute a large percentage of our imigration.

THE opening address of the President of the American Library Association, at its meeting at the Thousand Islands, brings out forcibly the lack of public library facilities in the City and State of New York and the pressing demand for improved legislation upon this subject.

It seems, that as the law enacted in 1872 never has and never can be applied to the organization of public libraries, the old district school system of 1835 is still practically maintained. And under its regulations the State has expended over $2,000,000, in the last thirty years, in supplying an inadequate and badly selected stock of books to district libraries, where they disappear almost as soon as distributed from the want of any system in their care.

This ruinous system was long ago abandoned by all the other States, having public library laws, as a failure. But it now stands as a barrier in the way of the introduction of a system that would cost little if any more than that now in operation, but serve a much more useful purpose. In the 22 free libraries of this State, which perform the functions of a public library, there are only 125,811 volumes all told; while the City of Boston alone has a public library upon which it annually expends $120,000, or doubtless much more than the aggregate value of all the books in all our free libraries.

This is really a shameful condition of affairs, and one that our law-makers should mend as speedily and effectually as possible. The City of New York is practically without a public library of any kind, for the Astor Library, with its stringent regulations, early closing hours and very general inaccessibility, is of very little use to the class that have the greatest need for a library, both of reference and general literature. Every other State which has a library law at all is in any event better off in legislation than the State of New York, and something ought to be done at once, and especially for this city. The demand for a properly organized and well-equipped library here is a pressing one, and the effect of such an institution, as that of Boston for example, would be immediate and great. If any one wishes to fully realize the utter poverty of New York in this respect, let him attempt the collection of data which may pertain to some treatise in hand, with private sources of information sealed to him. As far as the two best libraries of reference in this city are concerned, he will probably find the Astor closed just at the hours he has to spare upon such work, and the Lenox—shut all the time as far as the researches of a stranger may be concerned.

THE year of 1887 will long be marked in railway and financial circles as the year of the Baltimore & Ohio deal, by which a great railway system long noted for conservative and independent management, sound financial policy, and freedom from the frequent real and nominal changes of ownership that reduce so many railway investments to a pool-room basis, was suddenly thrown on the market and its good reputation, hardly earned by long years of wise administration, was dissipated in a moment. The range of prices in the common stock of the B. & O. for the year 1886 was 191 to 150. As we write it is changing hands at 120, which may be taken as a fair representation of the manner in which the acts of the present head of the company for the past few months have shaken public confidence.

The announcement of President GARRETT'S negotiations for placing the control of his system in Richmond Terminal hands was a thunderbolt to his stockholders. His subsequent entanglement with the famous (or infamous) IVES-STAYNOR syndicate was far worse, and the late exposures of the acts and assets of that illustrious pair must make the staid old financiers of Baltimore groan over the folly of the present generation, and sigh for the days when JOHN W. GARRETT, JOHNS HOPKINS, ROSS WINANS and BENJAMIN H. LATROBE made Baltimore famous.

The IVES-STAYNOR star has set in a cloud. The Cincinnati, Hamilton & Dayton has been rescued and is again under control of its real owners. The Vandalia line is back in the Pennsylvania's hands. And "conservative B. & O." is to be mortgaged for $10,000,000 to aid it out of a financial quagmire. It is no "two for a penny" set of financiers who have taken hold of the deal now. DREXEL, MORGAN & Co., and bankers of that stamp, form the present syndicate.

However much we may regret the loss of the Baltimore & Ohio as an independent system and its withdrawal from the unique position which it has so long held in the technical and financial world, it is fortunate that its control is coming into able hands and not into the stock gamblers' clutches which it has so narrowly escaped.

Extensions of the Chicago Lines.

In our issue of August 13, we reviewed the work upon which the Illinois Central and the three systems whose entrance to Chicago is of recent date, are expending their energies this season. Of the other Chicago systems, the Chicago & Alton is doing the least in the matter of extensions. This, however, is in accordance with their established policy, which has never been a "granger" one. It has been proposed to extend the branch, which now runs from Mexico, Mo., southwest to Jefferson City, 50 miles, across the Missouri river, and then south 120 miles to Springfield, Mo.; but while the people of the section through which the proposed line would run have evinced considerable interest, no active steps seem to have been taken by the company, and it is unlikely that anything will be done at present. The Missouri & Central Kansas Railroad Company, which was incorporated last February, is generally understood to be in this company's interest. A line is proposed from Odessa, Mo., southwest to Winfield, Kan. and thence to Caldwell and the Texas Panhandle. Surveys were made and a large amount of subsidies secured in the spring, but the recent drought seems to have dried up the project, and whether the Alton would find it profitable to build into a territory already abundantly supplied with railroad facilities, may well be doubted.

The Chicago, Rock Island & Pacific up to about two years ago pursued a policy and carried a class of traffic very similar to that of the Chicago & Alton, but since that time its rapidly pushed extensions have astonished even Kansas railway projectors. Its first move on the southwest extension was a line from Altamont, Mo., to St. Joseph. This was pushed on from that point 40 miles west. Here it separated, and one branch went northwest to the southern tier of Nebraska counties through which it was completed last spring as far west as Nelson, 207 miles from St. Joseph. The other branch runs south to Topeka and Herrington and there diverges, one line running south *via* Wichita, and the other southwest to Hutchinson, each of which cities are about 245 miles from St. Joseph. The Wichita line is now in operation to Caldwell near the south line of the State. Thence the line is to cross Indian Territory, running parallel to the new Santa Fé line, and will go to Fort Worth, Tex., to which point the final surveys are about completed. Several Texas cities have offered inducements for the extension of the line beyond Fort Worth, and it seems probable that the system will eventually have a terminus on the Gulf, but an entrance to Fort Worth will give it a good hold upon Texas traffic and will suffice for the present. The Hutchinson line is generally supposed to be the Pacific extension of the system. From Hutchinson grading and tracklaying are in progress *via* Turon, and Greensburg, 327 miles from St. Joseph, and the line leaves the State near the southwest corner of Seward county. Thence it runs across Indian Territory to Cisco, Tex., and through New Mexico and southern Nevada to the Pacific coast. This portion of the route, however, is still indefinite and surveys are making in different localities, while the company still refuses to avow any intention of owning a Pacific terminus. Besides the main lines across Kansas already noted, the Rock Island is building a line to Denver, branching from the Nebraska line in Thayer county, and running through the northern tier of Kansas counties. It is probable that this line will be continued east to Horton to avoid the detour through Nebraska, and will thus make an east and west air line from St. Joseph to the west line of the State, and thence, with hardly a change in its direction, to Denver. Other Kansas lines are being pushed. The Union Pacific tracks have been secured for the run from Topeka to Kansas City. From Poxico a line runs up the Republican Valley to Manhattan and Clay Center, and will be built on to connect with the Denver line. Other branches run to Sterling, Salina, Newton, and Atchison. In Nebraska work is in progress on a line to run from Omaha southwest, to connect with the Denver line near Belleville, Kan. By the system of extensions which the company has undertaken it is to come into direct rivalry with the Santa Fé. These two are to be the great systems of the Southwest, but at present, and for a long time to come, the untouched territory and undeveloped resources of that region are great enough so that there willbe prosperity enough for both, and the rivalry will be for profits rather than existence.

The Chicago, Burlington & Quincy is still desirous of a little more mileage in Illinois. The Illinois Valley & Northern road was incorporated in its interest last spring to build from Walnut to Streator, about 75 miles, and its early construction is quite certain. An extension to Quincy has been proposed of the branch now running to Rushville. In Wisconsin the company's intentions are more problematical. It is credited with an intention to enter Madison either by an extension of the branch now terminating at Rockford, Ill., or by a line from Galena. A more important project, and one about which more is known, is the extension of the Chicago, Burlington & Northern to Duluth from Lake Pepin, Minn., for which preliminary surveys were made last winter; and it is reported that land for terminals has been secured at Superior, Wis. Another project in which it is reported the Burlington & Northern is to interest itself is the Winona & Southwestern Railroad now under survey from Winona, Minnesota southwest to Mason City, Ia., about 100 miles. From this point control would be secured of the Mason City & Fort Dodge road, 72 miles in length, and its proposed extension to Council Bluffs would be pushed through, thus giving a direct line from Omaha northwest to Duluth. But these projects of the Burlington are not being pushed as is the work in their favorite State of Nebraska, where they have things pretty much their own way. At the beginning of last year they operated 1238 miles of road in that State. Last year they added to this about 400 miles, and this year 750 miles will be laid in the State and some 200 miles in Kansas, Colorado and Wyoming. The objective points of the Wyoming extensions are Cheyenne, Laramie, and the country west of the Black Hills. The Cheyenne line crosses the Union Pacific at Sterling, Col., and a line is under survey from this point to Greeley and Fort Collins, nearly 100 miles. From a point near Oxford, in the southwestern corner of Nebraska a line is being built across the northwest corner of Kansas and thence into Colorado, it is believed to Pueblo and Colorado Springs. Much interest is manifested in every move of the Burlington toward a Pacific extension and the Denver Board of Trade sent a very indignant protest to the company a few weeks ago because it was rumored that the Fort Collins line, mentioned above, was to be extended to the Pacific, thus leaving Denver off the main line. But that the company really intends to reach the Pacific coast there is little doubt. Considerable work has been done by surveyors already in Utah and Nevada. In the former State articles of incorporation were filed two months ago of the Utah Railway Company, to build from a point near the intersection of the thirty-ninth parallel and the western line of Colorado to Salt Lake City, about 320 miles, with a branch to the western line of the Territory, 125 miles in length. The stock of this company was practically all held by JAS. G. TAYLOR of Omaha, Assistant Treasurer of the Burlington system. In reference to the Nebraska lines of the system, it is noticeable that the extensions of this year are developing the central part of the State and opening up an entirely new country to settlement.

The Chicago & Northwestern is doing a little work on its lines in the north Michigan peninsula. The 35 mile extension from Iron River to Watersmeet has just been completed. A line has been surveyed from Felch Mountain to Republic, and will probably be extended to Ishpeming and Marquette. Nothing of importance is projected by the company in Illinois, Wisconsin or Iowa. In Minnesota surveyors are working on an extension to St. Paul, of the Zumbrota branch, which would give the company an entrance to that city independent of the Omaha, its present ally. In Dakota little is being done compared with last year's activity. The Redfield and Faulkton line is to be extended to Gettysburgh and Mound City, and 25 miles of track have been laid this year. The Fremont, Elkhorn & Missouri Valley company, however, is extending the Northwestern system considerably. The Black Hills line is being pushed on from Rapid City to Sturgis, about 40 miles, and a line from Sturgis to Deadwood, 8 miles, is being surveyed, and will be built next season. In Wyoming the track is being laid from Douglas west fifty miles to Fort Caspar. Although the company takes pains to deny all rumors that this line is intended to connect with the Oregon Pacific, and that that company is the Northwestern under another name, the rumors are nevertheless very generally believed. Work on the Oregon Pacific is being pushed at a good rate from Albany east to the Cascade mountains. In Nebraska the Fremont, Elkhorn & Missouri Valley is building quite an extensive system; about 275 miles will be laid this year extending to Geneva, Hastings, Albion, York and other points

The Chicago, Milwaukee & St. Paul will, like the Northwestern, hardly equal this year its last year's record of construction. The most important work of the year is the Kansas City line extending southwest from Ottumwa, Ia., and on which tracklaying is approaching completion. An entrance to St. Joseph has been secured of the St. Joseph & St. Louis company, whose tracks will be used from Lawson, 52 miles from St. Joseph. An important project of the company is the Nebraska Central line which has been for some months surveying and securing right of way from Omaha northwest and it is judged the St. Paul intends to make a granger campaign in Nebraska next season. It seems probable that the line will be pushed west to occupy the territory in the central western part of the State between the Nothwestern and Burlington systems, a country still undeveloped by railroad lines. In Dakota the company is doing but little compared with its work of last year. Tracklaying has recently been completed on the line from Elrod to Lake Preston, about 40 miles. The line which is eventually to run from Yankton *via* Roscoe to Bismarck is now in operation from Roscoe south 41 miles to Orient, and north 26 miles to Hillsview. It will not be pushed to Bismarck before next season. In Minnesota the only extension is one nine miles in length to Lake Minnetonka, built this summer. In Wisconsin the branch to Albany is being extended and will eventually reach Madison. A line is reported under consideration from Berlin north *via* Stevens Point to connect with the Wisconsin Valley division to Merrill. Construction is well along on the extension from Mer-

rill to Tomahawk Lake, 53 miles, and surveying parties are still working on lines from that point to the Gogebic iron range, and it is said also to Union Bay and Houghton.

From the above showing of the enormous amount of work which the Chicago systems have in progress there may be danger of the reader obtaining too great an idea of Chicago's importance as a railway center. From the statements given, its importance is manifest enough, and it should be said also that there are strong tendencies at work to lessen its prominence. The Northwest and Southwest are in the near future to have routes to the East and to export points independent of the Chicago routes, and able to give them a strong competition. It must eventually share a part of its prominence as a collecting and distributing center with cities in the Northwest and Southwest. How much, depends in a great degree upon the future policy of the systems whose work we have reviewed.

The Gothard Railway Grades.

We learn from one of our subscribers that he sent a translation into German of the articles which we published some time ago (ENGINEERING NEWS, April 16, May 14, 1887) questioning the propriety of introducing the spiral development tunnels on the Gothard Railway for the mere sake of reducing the rate of the mountain grades, to the present Chief Engineer of that line, whose reply lies before us, to the effect that he thinks it "hardly necessary to enter into" the question at length but that—

"The following statements will show that his theory in reference to the Gothard Railway is wrong."

The statement is as follows:

Length of Gothard Railway 266 kilos.	165 miles.
Income, about 10,500,000 fr.=	$2,100,000
Operating expenses 5,000,000 =	1,000,000

"*Therefore, the income is twice as much as the expenses.* [Italics ours. ED.]

Engines.	*4-wheeler.* Tons	*6-wheeler.* Tons.	*8-wheeler.* Tons.
Weight in operation	50.6	74.8	85.8
Pulling power up grades of			
1.9 % (52.8 ft. per mile)	275	440	550
2.7 % (142.6 ft. per mile)	77	154	187

Engines used on	*Valley line.*	*Mountain line.*
Express trains	One 4-wheeler	Two 6-wheelers.
Freight "	One 6-wheeler	Two 8-wheelers.

The velocity of the trains per hour, including stops at stations, was:—

	Valley line. Miles per hour.	*Mountain line.* Miles per hour.
Express trains	31.0	17.5
Passenger trains	18.6	12.5
Freight trains	12.7	7.5

The number of trains running each day over the mountain line is 16 in both directions [or each way, if we understand it.—ED] The traffic was:—

	Passengers.	*Freight.*
1883	1,056,'00	462,500 Tons.
1884	933,500	507,700 "
1885	983,400	543,700 "
1886	993,980	520,800 "

(Ton = 2204.7 lbs.).

"More facts about the actual cost of the mountain lines of the Gothard Railway are given in my article about the construction of the Royal Hungarian State Railway."

This crushing reply we give for what it is worth. It ought to be almost incredible that anyone occupying the position of Chief Engineer of so important a line could seriously imagine for a moment that the fact of expenses being only 50 per cent. of income gave any indication of the merit of the line as an engineering line, but unfortunately it is not. By this line of reasoning the Panama Railroad which used to be operated for ⅓ to ¼ of its receipts should be the best located in the world, and the West Shore road, which for a long time did not pay expenses, should be one of the worst! The true question is, of course,—Was it really wise to spend $50,000,000 to get spiral development tunnels and 5° 48′ curves, when something like $25,000,000 or $30,000,000 would have built the line with equal solidity and security with 10° maximum curves and without the development tunnels, the pusher grades being on a somewhat higher rate and proportionately shorter?

There can be but one answer to this question: Had it been done the expenses would not have been increased by any appreciable sum, and the present surplus of $1,100,000 which barely pays 5½ per cent. on the invested capital would have paid 8 or 10 per cent. This results from the fact that as respects curvature, the cost per degree of central angle is about the same regardless of radius within the limits of ready passage of trains at the required speeds, while as respects pusher grades, unlike through ruling grades, it is rather the total lift than the rate of ascent, which fixes the total cost of transit over it, if the grade be practically continuous and unbroken.

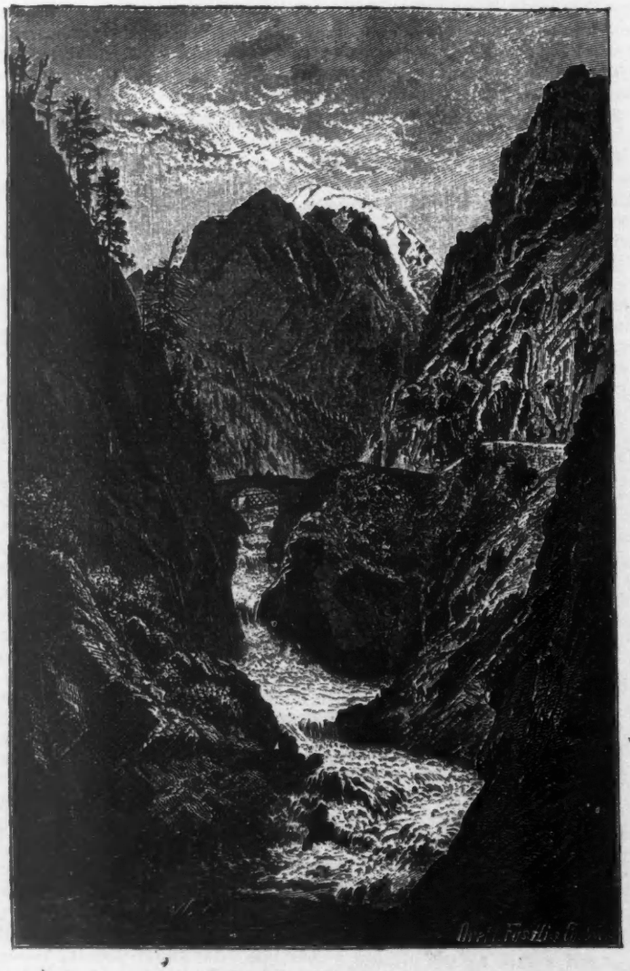
We mention this matter first, because it is the only thing in the nature of argument or evidence adduced in the figures given, and because it is evidently relied on as showing by proof of financial success that the laying out of the line is all right; but it is worth while tracing in the other figures given what of explanation there may be for the selection of a system of gradients which was undoubtedly so grave an error.

The first and most striking deviation from American standard of good practice is the extraordinary difference in the hauling power of locomotives on different grades. According to the memorandum of the Chief Engineer of the Gothard Railway, the relative hauling power of their engines on different grades are:

Grade	51-ton Eng.	75-ton Eng.	86-ton Eng.
1.0 p. c.	275	440	550
2.7 p. c.	77	154	187
Difference	198	286	363
Diff. p. c.	72.0	65.0	65.5

By the large inset table which we published in our issue of Mar. 12, 1887, in discussing "The Hauling Power of Locomotives" * the hauling power of American locomotives of the nearest corresponding total weights is:

	American.	Light Consol'n.	Av. Consol'n.
Total wt. tons	58	70	80
Wt. on drivers, tons	24	40	48
Load hauled 1.6 gr.	371	644	777
" " 2.7 "	136	253	307
Difference	235	391	470
Diff. p. c.	63.3	60.7	60.5



Dazio Grande.
Italian Side of St. Gothard Pass.

It will be observed that the percentage of decrease for increase of grade is not so very different, but that the absolute loads hauled on the different grades are enormously different, being 50 to 75 per cent. greater for American engines of the same total weight, and this in spite of the fact that the American engines of given weight have a materially less proportion of their weight on the drivers. In other words, if we compute the relative ratios of adhesion as nearly as may be from the somewhat inadequate data, we shall find that the ratio utilized in practice on the Gothard Railway is only from ¼ to ⅓ of the total weight on drivers, whereas in American engines it is ⅓.

This fact does not weaken in the slightest,

*Table 170 of "The Economic Theory of the Location of Railways."

but rather strengthens, the argument made as to the main point in dispute, that rather than incur such enormous expense for tunnel development for the mere sake of reducing grades, a higher rate of grade with a correspondingly shorter line should have been chosen, and that it would have given equally favorable operating results. For, even with the absurdly and inexcusably light European train-loads, it will be observed that the loss of net train-load is only some 65 per cent. for an increase of grade from 1.0 to 2.7 per cent. Now if we conceive two grade lines connecting two given termini, one on a 2.7 per cent. grade (with of course certain breaks for stations, etc.) and the other increased by development so as to give 2.7 times as long a line, and hence a 1.0 per cent. grade, a brief computation will show that the two lines stand to each other:

In length, as 1.0 to 2.7 or 63 per cent. difference.
In train-load, as per Gothard Railway practice as 2.85 to 1.0 or 65 per cent. difference.

In other words, what is gained on distance is lost in hauling power and *vice versa*, even with the low tractive efficienies of European practice, so that the choice of rates of grade *on grades of this kind* is almost a matter of indifference, since it takes almost precisely the same engine ton-mileage to move a car through between termini by any rate of grade between wide limits, and hence involves substantialiy the same expense.

How then can be explained the selection on so important a line of so low a grade at such tremendous cost? It comes in part from the fact that the very low tractive efficiencies in practice of European locomotives, combined with the resolute refusal of European engineers to learn from the everyday practice of this country that much higher efficiency is possible, have impressed their imagination with a horror of heavy grades as such. As to this difference we shall have a word to say later. But in the main it comes from a confusion of ideas as to the difference between grades and grades, a confusion which is lamentably common in this country also, although far less common than abroad. It is therefore worth while to again point out as concisely as may be, the nature of this difference.

There are three different kinds of grades, of very different nature and importance:

First, *minor grades* which do not fix the weight of trains, since they are on lower rates than the maximum. The rates and amounts of such grades are comparatively a matter of indifference, so that we need not dwell on them longer. The remaining two classes are:

Secondly, *pusher grades*, or long heavy grades over high summits, operated by auxiliary or separate motive power which is *adapted to the particular work to be done at that point only*, and on which two or three engines per train may be safely used if necessary. Such are the Gothard and most other mountain grades and we have just seen that on them the rate of grade is a matter of indifference. This is particularly the case when they are very long, so as to make it still less objectionable to operate them as a separate feature, making up trains anew for them if necessary; and it is still more particularly the case when the lower grade is obtainable only by *interpolated* development which does not advance us at all toward our final terminus. Even when this last condition is absent, however, so that reduction of our pusher grade to, say, half the rate, takes off just so much distance from the succeeding stretches of easy valley grades, it still remains substantially true that it is of trifling moment what the pusher rates may be, except that it is desirable to have them so adjusted to the lower grades that no breaking up of trains will be required.

Thirdly, we have: *Ruling grades proper* on long divisions over which the same engine takes the same train through and hauls the same train back. Such grades it is of extreme importance to have on the lowest rates possible, but, it it important only for these reasons, which do not obtain at all on the second class of grades.

1. It is not possible, or rather it is not safe and good practice to double up the motive power in order to run fewer trains and save train wages. To double up motive power for short trains on short stretches of heavy grade operated at low speed is one thing. To double up motive power merely to haul more cars at high speed over long stretches of easy and undulating grades is another and very different thing, and its appalling consequences under these latter conditions we have just seen in the Chatsworth disaster. The one is safe and proper; the other is dangerous and improper, although, as so often happens, irrational demands are being made on the strength of that incident, to have all double header trains done away with even on short pusher grades. But the main reason why heavy through grades are so disastrous is this:

2. The objection to heavy grades of any kind is not the extra work that engines have to do *on* them, but it is the work which they do *not* do (but might as well be doing) while they are off of them. In other words, there may be only six or eight miles of true ruling grades at various points on a division. In order to be able to handle its train when it reaches these few points the locomotive is only half loaded perhaps at all other points in its run of 100 miles *and back*, so that it takes twice as many trains with all the attendant expenses for motive power, train crews, maintenance of way, etc., to handle the same traffic. It is this only which makes heavy grades even of this kind so objectionable (and it does make them excessively objectionable) for if we could vary the power of our locomotive according to the demand on it, *as we do in effect on pusher grades*, there would be but a trifling objection to heavy grades, even if the cost of power per H. P. were no less than at present.

In non-attention to these paradoxical laws, which until the last few years might be sought for in vain in technical literature, we have beyond question the chief explanation of the selection of low rates of grade for such localities as the Swiss slope of the Gothard, where they are of most trifling real value. It seems perfectly logical to say:

1. Heavy ruling grades increase operating expenses.
2. Heavy grades require more hauling power on them.
3. They are more costly because they require more hauling power on them.
4. The heavier the grade the more hauling power required on them.
5. The heavier the grade the more costly to operate.
6. The heavier the grade the more money should be spent to reduce them.

This chain of argument sounds well, but it is nothing but a series of plausible and delusive, no-such-things.

What we have said so far, it may be remembered, refers only to the grades chosen for the Swiss slope of the mountain, with its three spiral tunnels. On the Italian slope the spirals were an utterless useless expense, since they accomplished absolutely nothing except to give a broken grade instead of a straight one *of the same rate*, the spirals having been introduced only to enable the railway to rise as fast as the valley at two narrow precipitious gorges and then follow the valley above and below on very easy grades. A straight tunnel instead of the spirals, through the primeval rocks which the accompanying view (cut from a little guide book) shows at the upper one of these gorges (Dazio Grande) would have carried the line right past these short obstructions in a way which we have already pointed out, and saved all the useless development. The still more indefensible defiance of American experience and practice in respect to curvatures, involved in adopting 5° 45′ maximum curves in such terrific country as this, it will be observed, is not touched upon at all in the memorandum above, nor could it well be, for it is not possible to defend it either on the score of safety, economy or necessary speed without shutting one's eyes blindly to the plain teaching of half a century of American experience.

We must repeat, therefore, that all which can fairly be said in favor of this magnificent specimen of *constructive* engineering is that as a piece of engineering design—to paraphraze the famous comment of the French general on the charge of the Light Brigade—"It is magnificent, but it is not civil engineering," except as the pyramid of Cheops is engineering. Constructively it is fine, but economically it is an atrocious waste of labor. We have no doubt that in matters of construction the engineers of the Gothard Railway were skilled and able men, and so absurd a reply as the above on an economic question, coming from such a quarter, may fairly be regarded as another evidence of the fact that engineers in general, and especially foreign engineers, have paid lamentably little attention to that side of their professional duties, as such. To point this most important moral, and in no sense for the mere sake of criticising errors of the past which are beyond all correction, we have discussed this matter in detail.

There remains the question of why there is such a great difference in the working tractive power of American and foreign locomotives, and whether that difference really exists. In part we have no doubt that the apparent difference is merely the result of the greater care to work engines to their full capacity in America, a care on which we should not plume ourselves too much, as it is enforced by the severest competition and the lower rates of this country, which make the utmost operating economy indispensable. As evidences of what differences may exist from this cause alone, the Lake Shore & Michigan Southern and several other roads increased their average train load from 50 to 75 per cent. within a few years without the slightest change in the engines. There was a change going on at the same time from iron to steel rails, but this would only account legitimately for a small part of the great increase stated. But a leading cause for the very marked contrast between the usual American ratios of adhesion, ⅓ to ½ the weight on drivers, and the usual European rates ⅓ to ⅕, is undoubtedly the broad distinction between the American and foreign locomotive in two respects, viz., the equalizing levers, ensuring an even and constant distribution of load on the drivers, and the swiveling truck, ensuring a smoother and safer motion, especially on curves. These peculiarities must eventually cease to be such by becoming universal, and it is little to the credit of foreign engineers that they have not become such already. But when concerns of the standing of the Baldwin Locomotive Works have publicly offered for years to furnish engines guaranteed to work up to ⅓ adhesion in regular service, it is little to the purpose to allege that the engines on the Gothard Railway will not, even if that fact would tend to justify the grades adopted, which we have seen is not the case. That American engines do in regular freight

service work up to ¼ adhesion is a fact so well established by overwhelming evidence that we do not deem it necessary to repeat the evidences of that fact which we have often given. If foreign engines cannot do this, but only work up to the absurdly light loads which the Chief Engineer of the Gothard Railway gives with a certain flourish above, why can they not do it?

New York Streets.

Mayor HEWITT, in giving his reasons for delay in filling the office of Street Cleaning Commissioner of New York, comes to the incontrovertible conclusion that if we had better pavements we could have cleaner streets. And in accounting for the present bad condition of our streets he details a series of reasons that are as shameful as they are true. Included in these charges we have the improper use of the roadways as a place of storage by merchants and builders for boxes, trucks and building material of all kinds that obstruct the passage of sweepers. But the most serious cause of all is the continual tearing up of our pavements for the laying of pipes and conduits for supplying water, heat, gas and electricity, and at no time in the history of New York has so much of this work been going on in nearly every direction. The very objectionable center-bearing street-railway rail is also referred to as interfering with street-cleaning by preventing the pavement from being kept flush with the outer side of the rail.

All of these objections are most justly made, and until some very radical measures are taken to suppress each and every one of them, in some manner, New York will continue to have bad pavements and dirty streets. The infringement on the public right-of-way is undoubtedly lawless and could be prevented now by proper legal enactment, or even by the enforcement of our present city ordinances relating to street obstructions The form of street-rail has been before referred to as deliberately devised to keep the public off of the railways, regardless of public comfort or even safety, and is a serious obstruction to good paving and proper street cleaning. This too is a matter that could properly come under the hands of the supposed guardians of the rights of the public as contrasted with the improper demands and misuse of privileges of corporations.

The tearing up of our streets is a more serious matter to adjust. Just now the most of this work is due to the introduction of systems of heating and lighting the city and of conveying intelligence that the previous generation neither dreamed of nor could make provision for. But the question arises whether we in our day are not disposing of this question by the most economical and expeditious methods, rather than in a permanent and proper manner. Much of the pipe system that is now being laid down is of a very temporary character, one that simply invites, and will actually demand, other and oft-repeated destruction and obstruction of our streets in its renewal and repair. No matter how well a pavement is originally laid, the best of it will not stand this continual breaking up and undermining of its foundation. And, furthermore, the work in progress seriously interferes with the business, comfort, and even health of the occupants of the streets operated upon.

Modern conditions doubtless demand a multiplicity of pipes and conduits under our streets; but modern civilization also demands that these systems should be laid in the best manner possible, be accessible at all times and for all purposes, and that the interests of the tax-payer and traveling public be duly considered. This brings us to the question of an ample subway which would contain the entire system. Such a solution of the problem would without doubt be enormously expensive at the start, but after all would it cost any more in the end than the continual doing and undoing of the present practice? Figures can be made to show that the City has paid out most extravagant sums of money for the very unsatisfactory pavements it now possesses, or rather it paid for a great number of very poor pavements. And it is altogether probable that long before any thoroughly satisfactory method is adopted for disposing of our underground system of pipes, we shall have spent the price of subways surpassing those of Paris in size and cost, and in addition have paid for and wasted several good, modern street pavements. It is bad financiering and worse logic to say that New York, as a city, cannot afford the expense of subways or other permanent improvement of similar effect, and yet to throw away in the course of years an equal or even greater amount in make-shifts that can never be satisfactory.

The U. S. Patent Office.

The last report of the United States Commissioner of Patents gives a very fair idea of the huge proportions of this thoroughly American institution. From 1790 to 1836 our patent system was substantially the same as that at present in use in England and the majority of Continental nations. And the total outcome of the first 46 years of its existence was—436 patents issued; a total executive force of 6 persons, with an aggregate salary of $6,850, and an annual revenue of less than $30,000.

On July 4, 1836, there was a complete revision of the entire legislation upon this subject, and the statute was approved which to-day stands almost unaltered upon our statute-books, and makes our patent law the most generous, just and best in the world.

The result of this change in policy is striking, as exemplified in the present report. In the fiscal year ending June 30, 1887, 25,619 patents were issued, an average of about 82 patents for every working day in the year. At the present time nearly 600 persons are required to transact the enormous business of the office, and it takes $650,000 annually to pay them off, while the annual revenue from this source, for the last official year, reached the sum of $1,200,000. This important bureau, instead of being a source of expense to the general Government, as is often the case elsewhere, not only pays all its own expenses, but actually has a surplus of over $3,000,000.

The last 50 years of the existence of this Department shows a wonderful contrast with the business and methods of the previous 46 years. And handsome as is its individual exhibit, the influence of our present wise and beneficent patent laws is so far-reaching, in its encouragement of a naturally inventive people, that we can only guess at the increase in national wealth and the advancement in the arts and sciences due almost solely to the working of our present system.

As showing the business transacted in one year, we quote a few of the items from the report. The total number of applications for patents, caveats, registration of trade-marks, etc., requiring investigation and action was 41,442. Out of 35,161 applications for patents on new inventions, 22,392, or about 68 per cent., were granted. The distribution of these patents among the several States of the Union shows that New York is ahead, with 4,121; Pennsylvania comes next with 2,289, but the Yankee State of Massachusetts comes sharp on her heels with 2,116. Illinois stands fourth in the list with 1798, and after that State comes New Jersey, Connecticut, Michigan, Indiana, California, Iowa, etc. in the order named. But when the fairer comparison by population is made, we have a very different exhibit. The "land of wooden nutmegs" then comes out ahead, as it should, and Connecticut shows one patent issued for every 729 inhabitants. Massachusetts comes next with 1 in 842, and New York stands 1 in 1,233 and Pennsylvania, 1 in 1,871, while Illinois has 1 in 1,711 of population. The Southern States do not seem to be prolific in inventive geniuses. South Carolina had only one patent to each batch of 21,640 inhabitants; North Carolina, 1 in 18,663; Virginia, 1 in 12,398 and Georgia, 1 in 11,015. Taking up the Gulf and Mississippi Valley States (South) we find Mississippi with one patent to 21,761 people; Alabama, 1 in 21,398 and Arkansas, 1 in 13,155; Louisiana does a little better with 1 in 9,804 and Missouri and Kentucky better still, with 1 in 3,165 and 1 in 6,568, respectively.

In the last year 1,489 patents were granted to residents of foreign countries, England, Canada, Germany and France, in the order named, obtaining 1,239 of them, The total number of patents issued since the formation of the department in 1790, is 387,045 as we understand the record.

English Railways in 1886.

The English Board of Trade has just issued its "Railway Returns" for 1886. By these returns it appears that the proportion of net receipts to paid-up capital was only 3.99 per cent., or the lowest figure since 1867, when the return was 3.91.. The total receipts, for 1886, were £69,591,953; the total mileage was 19,332, with 163 miles added in the year, and the earnings per mile were £3,600, or £29 less than in 1885, and £139 less than in 1884. The falling-off was in merchandise and mineral traffic, while passenger, parcel and mail traffic has increased to some extent. A comparison of the business of the last seven years (1880-86) shows that the tonnage of merchandise carried has steadily decreased since 1883, from 76,897,000 to 72,668,000 tons, but that the return for 1886 is higher than that of 1880, which was 69,635,000 tons. The mineral tonnage stands for three years as follows: 1880, 165,670,000; 1883, 189,486,000 (the maximum), and 1886, 181,941,000 tons. The number of passengers carried has steadily increased from 603,885,000, in 1880, to 725,584,000 in 1886. When the passenger traffic is divided under heads of classes, however, we find since 1880 a falling-off of 20 per cent. in the first class, and 7 per cent. in the second class, while the third class passenger traffic has increased 26½ per cent. The expenditures per mile were 52 per cent. of receipts, as against 53 in 1885, and 54 per cent. in 1875.

CORRESPONDENCE.

CORRECTION.—In Mr. A. D. OTTEWELL'S communication on page 128, in foot-note, for "longevity" read homogeneity.

The "Wa-ca-ma-ha-ga," or Looking Backward a Generation.

EDITOR ENGINEERING NEWS:

We have such a wealth of quasi scientific information now-a-days, scattered through so many periodicals devoted to its dissemination, that it is difficult for one who has his daily bread to win to do much more than read the headings, or lightly skim the varied articles, which appear from week to week, all alike challenging the attention of the seeker after truth.

I am by no means sure that the modern engineer is a more accomplished man for all this wealth of material at his command—on the contrary, the extent of investigation which modern thought calls for in the practice of any branch of art or science, inevitably leads of necessity to "specialities," and one meets daily with men of acknowledged high professional attainment in some walk, with whom but a short intercourse is necessary to leave one in little doubt what that specialty is, by reason of the obvious weakness they exhibit when enticed out of their groove, which by the way it is not always easy to effect.

I was led into this vein of thought by coming upon an odd volume of an engineering magazine published 36 years since (1851) wherein appeared occasional papers of a private club of engineers, mostly resident in Brooklyn, who met weekly at their several homes to discuss the professional news of the day. In their daily business, most of the members were specialists, but in the range of discussion, and the breadth of treatment of the subjects discussed at these meetings, the narrow bounds of specialty disappeared, and a stranger (introduced occasionally) would have been at a loss to determine to what branch of art, literature or science, the va-

rious members were attached. The individuals who at first were brought together by congeniality of tastes, were scarcely cognizant of any professional unity, but as their meetings progressed, and their interest in them enlarged, it was suggested that the results reached might be of value to others, and would bear publication, and to this end it were fitting that the society, if it could be called such, should have a name. The word club was not then in vogue, and the difficulty of selecting an appropriate name was finally solved by suggesting a combination of the initial letters of the names of the respective members, but it appeared that there was no initial vowel!—concluding to interpolate the first vowel, the result was the word Wa-ca-ma-ha-ga, (the *a* having the guttural sound of *aw*), a sufficiently euphonious Indian name, and one said to resemble very much in sound that of a sub-tribe somewhat noted for building wigwams, and also for disposing of enormous heaps of the bi-valves then found in some quantities on the coast; but the statement that the meaning of the word is *clam bake*, has no foundation in fact. The name, however, was considered as appropriate, and over that signature, they occasionally published engineering (then called Indianeering) papers on subjects which happened at the time to possess more or less local interest.

The editor of the magazine alluded to above, was subsequently elected as the vowel necessary to round out the name (the initial of his name being A) and its repetition was considered as no more than proper, in view of his onerous duties as scribe to the Wa-ca-ma-ha-ga "talks," and in their translation into the vernacular, and publication in his magazine. At a meeting, Dec. 1, 1851, the following resolution was offered: "That it was incompatible with the usual gravity of their proceedings to embark in such an enterprise, without some acknowledgment of the presiding genius of their tribe; accordingly, with the aid of some ab-original matter, an ode, or invocation, to their tutelary genius had been prepared, which, with their permission, would now be read:"

INVOCATION.

Spirit of the Wa-ca-mas!
Genius of steam!
Why shrink we all *craven*-like?
How can we still dream?

Spirit of the Wa-ca-mas!
Spirit without *guile!*
For this work make us *adam*-ant,
And direct with thy smile.

Spirit of the Wa-ca-mas!
Re-*morse*-less but just,
Let us not prove as recreant
Or false to our trust.

Spirit of the Wa-ca-mas!
Angel of *worth*-
Intone like thy thunder,
O guide thou our breath.

Spirit of the Wa-ca-mas!
Angel of hope,
With the demon of ignorance
Give us spirit to *cope*-

Land of the Wa-ca-mas!
Steam engines and gas-
Pipes, lead-works and force pumps,
Cast-iron and brass.

Where the men of the Wa-ca-mas,
Both early and late
Blow their own brazen trumpets—all
For the good of the State.

O, Spirit of the Wa-ca-mas!
Say us not *nay*-
Son of the Great Spirit,
To whom we now pray!

While the Society finally numbered about a dozen members, most of whom became members of the American Society of Civil Engineers, they then numbered but the half dozen whose names appear a little awkwardly in the above invocation, which was, of course, the purpose of the lines.

I am not aware of any society of engineers in our country having an earlier record than this, derived from an aboriginal tribe—few in number, it is true, but it contained the germ which exercised a material influence in the formation of the American Society of Civil Engineers, and most certainly potent in the revival of the latter Society in 1865, which, when founded in 1852, had an active representation from the Wa-ca-mas, and the tribe subsequently furnished five presidents; several vice presidents, and other officers, in the days when to hold such offices meant *work*. Notably among those was JAMES O. MORSE, long time secretary, whose scrupulous fidelity to trust during the interval occasioned by the war, which wrecked many stronger institutions, was instrumental in bringing about a financial condition which lifted the American Society of Civil Engineers on its feet at a time when its friends had almost despaired of such a result, and which enabled the Society to date its continuous life from that of its founding in 1852.

I have, Mr. Editor, unconsciously strayed somewhat from the theme of my text, which pointed in the direction of the complaint of the old relic of the Revolution, who, upon hearing some favorable mention of the brilliancy of the fire then burning on the hearth, said: "Ah! yes—but 'tis not the large red kind we had before the war." While this may be so in the present case, and it is surely pleasant to recall to mind so much of what was truly well worthy of remembrance, yet the hurry and bustle of to-day, is too urgent to expect the combatants to pause and waste time in counting those who have fallen, however bravely they bore themselves—and as for eulogy

"Fame to our ashes comes alas too late,
And praise sounds hollow on the coffin plate."

THE VOWEL.

NOTE: Membership at the adoption of the name of the Society: H. R. WORTHINGTON, CHAS. W. COPELAND, JAMES O. MORSE, JAMES HOW, C. M. GUILD. Additional members at the date Dec. 1, 1851: A. W. CRAVEN, J. W. ADAMS, JOSEPH NASON. Members subsequently added: G. V. FOX, Asst. Sec. of the Navy, Gen. GEO. S. GREENE, JAMES P. KIRKWOOD, W. E. WORTHEN, JAMES K. FORD, RICHARD S. SMITH.

Wanted; A Treatise on Wooden Trestles.

ENTERPRISE, FLA., Sept 1, 1887.

EDITOR ENGINEERING NEWS:

Your illustrations of wooden trestles, and editorial comments thereon, have greatly interested me, as they must every engineer in a country where there is an average of fully one permanent water-way for each mile of track, and, at least, for many years to come, they must be made of wood. Timber here is plenty while freights make iron expensive, and we have no materials of which to make foundations for heavy and permanent superstructures. I hope your mention of the strange lack of literature on this subject will lead some engineer, with a little time at his command, to supply the deficiency. Certainly a very large number of engineers would respond to a request for drawings and bills of materials of the style of trestles and small wooden bridges in use on their lines, and from a number of the best every engineer could devise structures to suit the varying conditions of length, height, strength and necessary water way. Trestles in this State are generally very poor affairs, everything being sacrificed to cheapness of first cost. Many of them need rebuilding, and should be made more substantial. We would like to profit by the experience of others, and I think could do so most conveniently through such a little work as suggested. We are under obligations to ENGINEERING NEWS for "opening the ball," and trust you will continue the work, but there are so many important matters demanding your attention that we can hardly hope for space in your columns to do the subject full justice. K.

[We fully agree with our correspondent, and believe there is a pressing demand for such a work by engineers situated as he is himself. We are now perfecting arrangements whereby we hope to give much more actual practice in this and similar construction to our readers, and in the meantime will be glad to receive all plans of standard works on railways that engineers may send us—ED. ENG. NEWS]

PERSONAL.

MR. JAMES S. COLEMAN was reappointed by Mayor HEWITT on September 7, Street Cleaning Commissioner for the City of New York.

MR. ROBERT BLICKENSDERFER, has been transferred from the General Superintendency of the Idaho Division of the Union Pacific to the same position on the Nebraska Division with headquarters at Omaha.

MR. W. B. BUDDICOM, who lately died in England, was one of the few survivors of the great railway pioneers of 50 years ago. He was born in 1816. In 1836, he was resident engineer on the Manchester & Liverpool Railway, and was engineer of the Glasgow, Greenock & Paisley Railway from 1838 to 1840. In 1841 he was called to France to erect works for building the rolling stock of the Paris & Rouen railway, and held a contract for working that railway until 1860. He was connected with Messrs BRASSEY and others in building the Bellegarde tunnel on the Lyons & Geneva road, and in constructing and working the temporary Fell's railway at Mount Cenis. He retired from active service in 1864.

SOCIETY PROCEEDINGS.

The New York Technischen Vereins, an association of German civil and mechanical engineers, architects and chemists, held a convention in this city last week at the headquarters of the society. Some thirty delegates from distant cities were present, and papers were read and excursions made to points of interest, including the New Croton Aqueduct, and the elevated and cable railways. The membership is now 370, scattered over five States.

The American Society of Civil Engineers held its first meeting for the season of 1887-88 at its house on Wednesday evening, Sept. 7, Director C. C. SCHNEIDER presiding. The Secretary announced the death since last regular meeting of THOMAS W. NICOL, Assoc., ALBERT J. STAHLBERG, Junior, and FREDERICK KRUPP, Fellow of the Society. The usual measures were taken for the preparation of memoirs of the above. Mr. BOGART also announced that the building fund, started at the late Convention, now exceeded the sum of $8,000, and the Board of Direction had appointed a committee to secure further subscriptions for a larger house for the Society. The names of this committee have already been published. The papers for the evening were read by the Secretary and they consisted of discussions on "Inspection and Maintenance of Bridges," as presented to the Convention at the Kaaterskills. These discussions were by W. S. LINCOLN, Chief Engineer, Wabash, St. Louis & Pacific R. R., and R. A. SHAILER, of Chicago, and related chiefly to standard floor system with their guard-rails, and re-railing devices, grade crossings, etc. Mr. F. C. WEIR presented to the Society a series of lithographs of 3-truss Howe bridges erected in 1840 on the line of the Moscow, St. Petersburg Railway. The wood used was all planed and burnetized.

In 1861 Mr. WEIR and others inspected these bridges with Mr. HARRIS, of Springfield, Mass., as the expert, and they were found sound in all respects, and some at least are in use to this day. The lithographs were very interesting in the completeness of detail given; the trusses were generally triple intersection, and one showed a continuous girder application with the roadway on the middle line of truss, this latter being practically two Howe trusses with the floor system between them. The Secretary further announced that Lieut. ROGERS, U. S. N., who lately reported upon the Panama Canal, will shortly read a paper upon this subject before the Society. It was also announced that the Publication Committee had determined to issue the Transactions hereafter in half-yearly volumes, as the papers had increased to such an extent that an annual volume was too bulky. The following were elected to the several grades named:

FOR MEMBERS.

CALVIN HARLOW ALLEN, Buffalo and State Line R. First Vice-President Buffalo, New York and Philadelphia R. R., New York City; ROBERT BUNKER COLEMAN BEMENT, now engaged in planning and constructing Water-Works, St. Paul, Minn.; PETER FRANKLIN BRENDLINGER, Engineer Pennsylvania Schuylkill Valley R. R., Pottsville, Pa.; ALBA FIFE BROWN, General Manager Keystone Bridge Co., Pittsburg, Pa.; GEORGE DEVIN, recently engaged in Railroad Bridge and general engineering work for THEODORE COOPER, M. Am. Soc. C. E., New York City; ROSCOE EDWIN FARNHAM, Assistant Chief Engineer of Chicago & Northwestern R. R. Chicago, Ill.; CHARLES HALLETT GRAHAM, Assistant Engineer Department of Public Parks, New York City; CHARLES HARLOWE, Locating Engineer Chicago, Burlington and Northern R. R.; DAVID CHRISTIAN HENNY, Assistant to J. A. L. WADDELL, M. Am. Soc. C. E., Cleveland, Ohio; EDWARD WILLARD HOWE, Assistant Engineer, in charge of Park Construction, Boston, Mass.; WILLIAM DUNBAR JENKINS, Engineer in charge Randolph Bridge over Missouri River for Chicago, Milwaukee & St. Paul Ry., Kansas City, Mo.; HORACE GREELEY JOHNSTON, City Engineer of Salina, and County Surveyor of Salina County, Kansas; ALFRED POTTER KIRTLAND, Superintendent Western Pennsylvania Div. Pennsylvania R. R.; Blairsville, Pa.; FREDERICK NASH OWEN, Civil and Sanitary Engineer, New York City; ALFRED HOLDEN SIMPSON, engaged in directing work on behalf of the Contractors upon the Dry Dock at Newport News, Va.; OTTO FREDERICK SCHNE, Principal Assistant Engineer Sibley Bridge, Orrick, Mo.; WILLIAM STARLING, Chief Engineer Mississippi Levee District, Greenville, Miss.; ALFRED THOMAS

TOMLINSON, in charge Construction Red Hill Tunnel, Denver & Rio Grande R. R., Badger, Col.; FRANCIS STUART WILLIAMSON, Engineer Wallis Iron Works, Jersey City, N. J.

FOR JUNIORS.

JULIUS BAIER, Asst. Engineer with ROBERT MOORE, St. Louis, Mo.; GILBERT JAMES BELL, Asst. Engineer, Sibley Bridge, Orrick, Mo.; FRANK BERESFORD, Principal Assistant Engineer Cincinnati, Hamilton & Dayton R. R., Cincinnati, Ohio; EDWIN MITCHELL, Assistant Engineer of Sewers, Norfolk, Va.; GEORGE RICHARDS SIKES, with United States Construction Co. of Philadelphia designing Cable Roads, Philadelphia, Pa.; GEORGE OLIVER TENNEY, in charge of Decatur Land Improvement and Furnace Co., Decatur, Ala.; YOSHICHIKA WADA, (Imperial Univ. Tokio, Japan, 1885.) in Engineer's office, Sibley Bridge, Orrick, Mo.

PUBLICATIONS RECEIVED.

Manual of the Railroads of the United States for 1887, showing their route and mileage: stocks, bonds, debts, cost, traffic, earnings, expenses and dividends; their organizations, Directors, Officers, etc., by HENRY V. POOR, pp. 1053. *H. V. & H. W. Poor*, Publishers, 70 Wall St., New York.

This twentieth edition of what is now the acknowledged standard authority on all matter pertaining to American railroads, has just been received and shows several features of marked improvement over the last year's number. In place of the hit or miss arrangement of the different companies, which last year took the place of the former arrangement by States, there is adopted an arrangement by geographical subdivisions consisting of adjoining States whose railway lines are to some extent a system by themselves; the same principle of classification, in fact, which we have adopted in our map series and our construction news. The value of this subdivision is almost wholly neutralized, however, from the fact that the headlines of the pages are a curious jumble of those in use in different previous editions, and do not state at all to which division the roads on the page belong. It is thus still necessary to go first to the general index to find the name of a road, and the careful geographical and alphabetical arrangement is of little use. The maps are a great improvement over those of last year and seem to have been brought down to date with a good deal of care.

The summary of statistics contained in the introduction is of much interest, and we condense a portion:—The number of miles of railroad constructed in the United States in 1886 was 9,000, the aggregate mileage for the whole country completed at the close of the year being 137,986; the rate of increase during the year being 7.8 per cent. The amount of share capital and indebtedness of all the companies for 1886 equalled $8,163,148 652, against $7,842,533,179 for 1885, the increase equaling $320,615,473, the rate of increase being about 4.09 per cent.

The earnings from freight equalled $550,359,054; from passengers, $211,929,857; from miscellaneous sources $59,903,038. The operating expenses of all the roads for the year equalled $324,880,334, the net earnings being $297,311,615. The gross earnings upon the entire capital invested exceeded 10 per cent.; the net nearly equalled 3.5 per cent. The amount of interest paid the last year equalled $189,036,304, against $187,426,035 for 1885; of dividends, $81,654,136, against $77,672,105 for 1885. The percentage of interest paid on the funded debts of the companies, the past year, equalled 4.75 per cent., against 4.77 per cent. for 1885. The percentage of dividends paid to the whole share capital equalled 2.04 per cent., against 2.02 per cent. for 1885. The earnings per mile of lines operated the past year equalled $6,750, against 6,565 per mile for 1885.

The traffic operations for the year were largely in excess of any previous year, but the increase in the volume of the traffic was nevertheless little above the average increase of past years, and is indicative of a healthy revival in the business of the country, and a continuance of its development rather than of any extraordinary movement due to speculative causes. The exhibit of earnings is made still more gratifying by the reduction in the cost of operating the roads, the total cost in 1886 being 63.84 per cent. of gross earnings, against 65.12 per cent. in 1885, the reduction being due chiefly to improved methods and the introduction of necessary economies. The earnings for 1887 are likely to equal $900,000,000, the increase to equal fully ten per cent over that of 1886. The increase in the investment upon which such earnings are based will not probably exceed 3 per cent. Hereafter it seems probable that the earnings of our railroads are to increase in ratio considerably greater than the amount of capital invested in them.

Kingston, Ont.—The Montreal *Star* says that the water company refused to, hand over the system to the city on September 1. If the city forces its demand, the company will take advantage of all its legal rights.

Early Suspension Bridges.

According to Sir J. RENNIE the invention of chain or suspension bridges is said to have been imported from China and India. The first of the kind in England was that across the Tees, at Middleton, consisting of two common chains stretched across the river, and secured to the adjoining banks; the span was 70 ft. To Captain Sir SAMUEL BROWN, however, who had previously brought chain cables into use for ships, may be attributed the introduction into England of the improved system of the bar link, which is now so generally adopted. BROWN, in 1818, first constructed a large model of 100 ft. span, capable of supporting a carriage and horses, indeed adapted for general traffic. He afterwards constructed (1819), upon this principle, Union bridge, for general traffic across the Tweed, near Berwick; the span was 450 ft. between the supporting towers, which were of masonry. He subsequently built another, of smaller dimensions, across the Tweed at Dryburg. He also constructed that at Montrose, one over the Hundred Feet river in the Fens, and others, and applied the same principle with effect for landing-piers at Brighton and Leith.

This system was afterwards carried out to a far greater extent by TELFORD, in his great suspension bridge acros the Menai at Bangor in 1818-20, so well described by PROVIS. It consists of three openings: the center is 580-ft. span, the deflection of the chain being 42 ft., and the two side openings are 260-ft. span each; the platform of the roadway is 100 ft. above high-water mark; the sustaining towers of masonry are 50 ft. above the roadway, and are connected to the shore by three stone arches on one side and four on the other, 52 ft. 6 in. span each. There are sixteen main chains, each 1,770 ft. long, in sets of four each, suspended above each other on each side of the roadway, which is 30 ft. wide from out to out, divided into three parts, two for carriages on the outside 12 ft. wide each, and one for foot passengers in the middle 6 ft wide. Each chain consists of five bars or links, 10 ft. long each, by 3½ in. and 1⅛ in., connected together by plates and pins, on Brown's system, the whole being properly secured to the solid rock on each side. The total suspended weight of the main opening is 644 tons.

About the same time he constructed another upon the same principles, 300 ft. span, across the river Conway, at Conway. These are fine works, and will remain as lasting monuments to his fame.

But the claim for priority of Sir SAMUEL BROWN is antedated 22 years by the chain suspension bridge built by JAMES FINLAY, in 1796, over Jacobs's creek, near Uniontown, Pa. This bridge was patented in 1801, and in 1811 eight bridges had been built on this plan.

The oldest Chinese suspension bridge, according to their own traditions and history, dates back nearly 2,000 years; it was in the province of Yunnan. A much larger chain bridge spanned the river Pei during the Ming dynasty, and another bridge of this character 1190 ft. in span, is said to have been built A. D. 65.

The Passenger Traffic of London.

Communication with the interior of London is secured by four great systems (1) the Metropolitan Railway, (2) the District Railway, (3) the General Omnibus Company and (4) by the tramways. In 1886 each inhabitant of London made an average of 90 trips in some of the vehicles belonging to these systems, without counting travel on the other railways terminating in London or by cabs. This average, however, falls far short of the individual movement of passengers in New York, where the traffic of the elevated roads and street surface cars represents an average of 200 trips per annum per inhabitant. London, with its vast population, could easily double or triple its present average if it possessed more perfect means of rapid transit, as can be seen from a comparison between the travel of 1864 and that of 1874.

In 1864 the Metropolitan Railway Co. and the General Omnibus Co. alone existed. The first then transported annually 42,000,000 of passengers and the second, 11,000,000; or about 18 times the entire population of the city then figured at 2,940,000 inhabitants. The mean receipt per passenger was about 7 cents for the omnibus and 5 cents for the railway. Between 1864 and 1874, two new systems of travel were opened—the District Railway and the network of tramways. As showing what this increased facility for circulation meant it is sufficient to note that at the end of 1874 the total of passengers per annum stood as follows:

General Omnibus Co	48 millions.
Metropolitan Railway	44 "
District "	21 "
Tramways	42 "
Total	155 millions.

The population of London in 1874 had reached 3,420,000, and consequently each inhabitant could be credited with an average of 45 trips over the city lines, as against 18 trips in 1864. On the other hand as the public become more accustomed to the use of these means of quick transport, it used it the more for short distances, with the result that the average receipt per passenger fell to 5⅞, 5, 4½ and 4¼ cents for each of the four companies in the order named above. Though this result was also partly due to a combination between the tramways and the other and more powerful companies.

From 1874 to 1884 the network of tramways was rapidly developed, and at the same time the railways threw out branch lines into the suburbs and even beyond. In 1884 the circulation on the four great lines amounted to 308,000,000; or, dividing with a population of 4,000,000, an average of 77 trips per inhabitant. The relative amount of travel then stood as follows between the four great systems:

	Passengers	Av. Rec'pt. per Trav.
General Omnibus Co	75,000,000	4.16 cts.
Metropolitan Railway	76,000,000	4.16 "
District Railway	38 500,000	5.64 "
Tramways	119,000,000	3.20 "
Total	308,500,000	

These figures show that in the space of 20 years the population had increased 36 per cent.; the average annual trips per inhabitant, 330 per cent., and the total passenger circulation, 500 per cent And these figures do not include the almost countless number of commutors who daily arrive at each of the forty railway stations of London and pass to their destination by other means.

A New Mining Safety Blasting Cartridge.

A mining cartridge has been successfully introduced in the Durham coalfield by Mr. JOSEPH ROUTLEDGE, of the Ryhope Colliery, Ryhope, near Sunderland Mr. ROUTLEDGE'S cartridge case in made is a cylindrical form, divided into two sections, the outer case to hold the water, and the inner case containing the powder, both cases being made of thin sheet tin, brass, or waterproof paper, and of various sizes to suit either light or heavy work. The smallest has a capacity for 3¼ oz. of powder, and this cartridge is placed in a hole of 20 in. by 1¾ in. bored into the coal or stone. For heavy canches, driving, and general stone work, the cartridge contains 7¼ oz. of powder, and the depth of the hole required is 32 by 1¾ in.

In charging the cartridge case for a blast, water is put in at the open end of the outer case, and the inner case having been previously charged with powder is inserted into the outer case, and when put into its place makes a water-tight joint. There is thus a layer of water all round the powder case, and the most water is between the powder and the outer end of the bore-hole. The firing cord is inserted in the powder, and the hole is tightly corked up. The cartridge is then placed in the bore-hole with the water end outwards. The powder charge is fired by a small electric battery, insulated cable, and detonator. Any miner can use the cartridge, and as will be seen, the operation of charging the cartridge and cases is a very simple matter. The cartridge is a handy and convenient one, and if the inventor's directions are followed it is claimed that all flame and sparks from the powder are arrested at the seat of the blast, and do not rush out of the bore-hole to communicate with either inflammable gas or coal dust.—*Iron & Coal Trades Review.*

THE new Paris post office is said to be lying practically idle and unused because of the difficulty of discovering elevators that can be considered safe. This is not complimentary to French mechanical engineers, especially as those originally put in have been condemned and removed. The London *Architect* recommends the Frenchmen to come to London for their "lifts." To which we would say yes, if they want a safe and slow type. But if they would unite safety with speed they will have to call on American makers.

The Typhoid Fever Bacillus.

Mr. DESMOND FITZGERALD, M. Am. Soc. C. E., writes to the Boston *Advertiser* concerning the researches of French scientists for the germs of typhoid fever and their discovery in bacteria existing in impure water. Mr. FITZGERALD says that while lately in Paris he had an opportunity to personally examine, under a microscope, some of the living germs taken from the bodies of persons suffering from typhoid fever, and from other investigations made since by himself, he is convinced that the disease may be communicated by means of bacilli carried in drinking water.

This has long been suspected in the medical world, but satisfactory proof was lacking until some months since when Doctors CHANTEMESSE and WIDAL, bacteriologists and assistants of PASTEUR, made an extended study of the growth and development of the typhoid microbe. These gentlemen were enabled to fully identify the bacillus and to cultivate it under various interesting conditions. While the honor of the discovery of the bacillus belongs to EBERTH, the doctors named have identified its peculiarities and made it possible for any other investigator to detect its presence. It can not be recognized by the microscope alone, as it is similar in form to hundreds of others, but it is only when cultivated under special conditions that it can be known.

The Paris doctors show that the water of the Seine contains the bacilli of typhoid fever, and hence account for the increased number of typhoid cases which appear as soon as this water is turned into the city distribution, as it is almost every year in certain quarters. In 1882 there were 3353 deaths from typhoid fever in Paris. In the first six months there were 965 deaths; in August the number reached 325; in September, 275, and in October the mortality from this cause suddenly sprang to 860. The number diminished rapidly in November and December. It was in the most fatal months that much water from the Seine was consumed. Dr. CHANTEMESSE said that in 19 cases out of 20 of persons suffering from typhoid fever he never failed to to find the typhoid bacilli in certain parts of the body. It is never found in the heart, and the moment convalescence begins the bacillus disappears. The labors of these physicians have enabled them to definitely state the following proposition. "Typhoid fever is a malady arising from a specific parasite—produced by a micro-organism of a special character always to be found on the living patient and only in the progress of the disease."

Mr. FITZGERALD, in his letter, cites other and special cases proving the experience and statements of the physicians quoted. The peculiar bacillus has been found in well water which had brought on typhoid in persons using it. And an experiment was made which has a pertinent bearing on the necessity for cleaning the sides and bottoms of reservoirs, etc. Water was poured over some earth in the bottom of a flask and some colonies of the bacillus were cultivated in the water. At the end of two months, when the water failed to show any specific germs or spores, the water was gently decanted and replaced by ordinary water poured in on the sand and earth. The next day this water was found charged with typhoid bacilli.

A NEW grip for cable cars has just been patented by a Kansas City man. The object of this invention is to provide a grip that will be more powerful and positive in action than those heretofore used. In this grip is provided two levers, a raising and a lowering lever and a power or gripping lever. The raising and lowering lever is provided with devices at its upper end for holding it in any desired position, and its lower end is rigidly attached to an exterior cam. The exterior cam is adapted to engage the upper surface of a jaw to press it down upon the cable, and an interior cam is mounted on a journal carried by opposite cross-bars of the frame. The exterior cam is mounted upon and is carried by the internal cam, both cams being carried by and operated on a journal that is common to both. This arrangement may be termed a cam within a cam, the interior cam forming a journal for the exterior cam. In simplicity of design and easy working this grip is claimed to exceed anything heretofore invented.

CONSTRUCTION NEWS.

Water.

Water Works Wanted.—The city of Weatherford. TEX., is desirous of negotiating with some water-works company to furnish the means and put in water-works. The city will grant a liberal franchise and take some hydrants. No local company has been organized and the city is unable to build. For particulars address MATT. C. CAMERON.

The Pawtucket Pumping Engines, according to a report in the Providence, R. I., *Journal*, have just made a run of 21 days without stopping, and a duty of 127,000,000 lbs. Mr. EDWIN DARLING, the Superintendent of the water-works, is reported as being very proud of the record of his engines, and he has a good right to be if the figures are anywhere near correctly reported.

Kent, O.—At a special meeting of the Council on Sept. 2nd the new water-works were accepted by the following resolution: "That the water-works as constructed and completed by the Kent Water Co. for the village of Kent be and are hereby approved by this Council, and that the hydrant rentals commence on Aug. 5, 1887, as per conditions of contract." Mr. ISAAC S. CASSIN, Chief Engineer, has made a written agreement to extend certain of the pipe lines immediately on the acceptance of the works. On September 1st two fires occurred and the new water supply was used to extinguish them. The efficiency and importance of the system was practically shown, and the acceptance of the works has given general satisfaction.

New Water-Works.—*Maine.*—Bar Harbor. At a meeting of the Eden Water Co., Sept. 1, it was voted to begin work at once upon the new water supply system, which will include all the territory between Hull's Cove and Schooner Head, including Bar Harbor. CHARLES T. How, of Boston, is President of the company, the capital stock of which is $150,000, with $100,000 supplied.

Massachusetts.—Marblehead. The new water-works system on Marblehead Neck, established by the Marblehead Water Co., is giving the utmost satisfaction, and the hotels and cottages are taking it as fast as connections can be made. The system, being carried into old Marblehead, has supplied a great want. It is found that there is pressure enough to throw a stream over the highest building in the town, and the effect on real estate and insurance will, it is expected, be very beneficial.

New York.—Springville. Pipe laying will be commenced shortly and water furnished before winter——Nunda Works are to be constructed.

Virginia.—Tazewell C. H. Water-works are to be built, Address JAMES ALLEN.——Manchester, Water-works are contemplated.

Ohio.—Findlay. The plans prepared by JOHN W HILL, C. E., for water-works, have been accepted, and the work is now being advertised. (*See first cover page.*)

Kentucky.—Paris. Address the mayor for particulars respecting the proposed water-works. A company is being organized.

South Carolina.—Yorkville. Water-works are contemplated, but nothing definite has yet been decided upon.

Illinois.—Oak Park. A company is to be incorporated to build water-works.

Minnesota.—Rochester. At the official test of the recently completed works, a stream was thrown to a height of 100 ft. with engine pressure, 5 other streams playing at the same time. The council accepted the works by a tie vote, the mayor casting an affirmative deciding vote.

Wisconsin.—Marinette. The construction of the new water-works will soon be commenced.

Dakota.—Bismarck. Work is progressing rapidly with the trenching and pipe laying; about 5¼ miles of mains will be laid this year. The reservoirs are also under construction.

Arkansas.—Pine Bluff. The Water, Light & Power Co., of St. Louis, Mo., will soon commence work on its water works contract.

Texas.—Galveston. The water-works, which have been authorized by the legislature, will be constructed shortly.

California.—Templeton. There is a strong feeling in favor of a water supply and measures are being started to establish works.——Nipomo. The water-works are under construction.

Portland, Ore.—At a recent regular meeting of the water committee, the special committee appointed to prepare, in conjunction with the superintendent, a map, plans and specifications for the proposed extensions of the low service distributior system and improvement and extension of the high service distribution system, presented a report recommending that the work be done in accordance with the plan and estimate of the superintendent submitted therewith. The plan proposes that distribution pipes for both high and low service systems be laid "at intervals of not more than one block on all graded streets within the city limits, as shown in the office map," with new pumping apparatus for the high service. Based upon prices paid on the last contracts awarded, viz., $49 per short ton for pipe delivered along the streets: 3¼c per pound for specials; gates, lead and labor in laying at former prices, the estimate of cost is as follows:

HIGH SERVICE.

Pumps (making use of present pump-house)	$ 6,000
Pipe, 6.6 miles, 229 tons	46,011
Gates	772
Lead	1,750
Specials, 74,370 lbs	2,417
Labor	5,500
Total for high service	$62,550

LOW SERVICE

Pipe, 12.4 miles, 1058 tons	$51,842
Gates	968
Specials, 88,136 lbs	2,864
Lead, 24 tons	2,400
Labor	8,400
Total for low service	66,474
Making total estimated cost	129,094

The subject received lengthy consideration, and upon motion it was unanimously agreed that it be recommended to the general committee that the plan be adopted, that proposals for furnishing the materials be obtained on the earliest practicable day, and that the work be commenced and pushed with the utmost vigor.

Accompanying the report of the sub-committee was the report of Superintendent SMITH, together with a map showing the streets in which mains are to be laid, and the size of each, and giving in detail a statement of material required for the additional distribution system The different sized pipe required is as follows:

FOR THE HIGH SERVICE.

	Tons.
1.1 miles, 12 in. pipe, 88 lbs to the foot	225
2.4 miles, 10 in. pipe, 68 lbs to the foot	468
1.6 miles, 6 in. pipe, 34 lbs to the foot	144
1.3 miles, 4 in. pipe, 21 lbs to the foot	73
6.6	2.09

FOR THE LOW SERVICE.

1.3 miles, 10 in. pipe, 63 lbs to the foot	216
1.3 miles, 8 in. pipe, 46 lbs to the foot	157
5.2 miles, 6 in. pipe, 32 lbs to the foot	442
4.6 miles, 4 in. pipe, 20 lbs to the foot	243
12.4	1058

The high-service mains are adapted to a pressure of 220 lbs. and the low service mains to 200 lbs. The action of the committee will give a water main to every graded street in the city limits. It discounts the future a few years, but the committee decided that it would be better to do at once and do thoroughly whatever was necessary to furnish every part of the city with water than to lay here and there a few hundred yards of mains as each district petitioned for them. The plan adopted yesterday is practically the one which was proposed for the Bull Run system, and in case water should in after years be brought in by gravitation, no change will be necessary in the distribution system. The item of $6,000 for a high service pump is a necessity as the present pump is nearly worn out. The additional system will necessitate the sale of about $120,000 more bonds, entailing interest charges of $600 a month more or a total of $31,000 per annum. It is thought that the additional revenue to be derived from the larger distribution will not, for the first year, meet the additional interest charges, but the time is not far distant when it will. The enlarged distribution will greatly stimulate the building of dwellings in the outskirts of the city. Many owners of lots would have built this year were it not for the fact that they would be obliged to lay pipes for two or three blocks in order to reach a main. Under the enlarged system, no property on a graded street will be more than half a block from a main.

Water Supply from the Morris Canal.—There is a strong opposition to the scheme to take the Morris canal as a source of water supply for Newark and Jersey City, N. J., it being held that the State has certain vested rights in the canal that cannot be taken from it without injury to the commonwealth. In discussing this matter, the Jersey City *Eagle* says: "No matter what proposition may be made to Jersey City, it cannot be anything less than a swindle upon some other part of the community in the State. The Morris canal cannot supply water to Newark and Jersey City without damaging the State's interest in the Morris canal; neither can it serve Jersey City as one master, and the citizens along the canal as the other. The object of the charter was to benefit the towns through which the canal passes by giving the shippers cheap freightage. The canal company cannot fulfill the objects of its charter and give a responsible water supply as well. It has been decided by the State, in protecting its own interest, that the canal can only sell its surplus water. As the canal company has no surplus water to sell, how can it sell it?

St. Louis River Water Power Co.—The recent sale of an interest in this company is an important event for Duluth, Minn., and the region at the head of Lake Superior. The St. Louis Water Power Co. was organized by Jay Cook and others in 1870, and the franchise to the power secured for 12 miles, from Fond du Lac to Thompson, which includes the famous falles of the

river, which descend 500 ft. in the 12 miles. The original capital of the company was $1,000,000, but within a year or two it was increased to $2,000,000. The sale includes a quarter of the whole, $500,000 at par value. The money goes into the treasury, and will be used in the construction of the first dam, and perhaps of others. The first dam will be located at the foot of the rapids, and dredging will easily make the river navigable to it. It will be 800 ft. long and 20 ft. high. This will turn the river into an old channel on the south side, which enters the river again below the head of navigation, thus forming a natural basin for the waters, having several hundred feet of area. Outside of the immense power, the advantage of the location is that at a comparatively small cost for dredging the river in a few places it can be made accessible to the largest lake boats coming to Duluth. The first dam will have 5,000 H. P., and even at the lowest stage of water can grind 12,000 barrels of flour a day, and by the other dams the power will be increased ten-fold. Surveys have been made for all the dams, and their power is as follows:

	Height.	Head & Fall.	Horse Power.
Dam No. 1	20 feet.	30 feet	5,000
" 2	15 "	20 "	3,600
" 3	15 "	20 "	3,600
" 4	10 "	40 "	7,215
" 5	10 "	30 "	5,000
" 6	10 "	25 "	4,526
" 7	10 "	40 "	7,215
" 8	10 "	30 "	5,000
" 9	15 "	25 "	4.52
" 10	9 "	101 "	18,030
Total	124 feet	364 feet.	63,712

JAMES SMITH, JR., is President, and JAMES M. BUTLER of Philadelphia, Secretary of the company.

Proposals Open.

City Bonds.—Paving bonds, $75,000; curbing bonds, $21,000; sewer bonds, $100,000. JOHN RUSH, City Treasurer. Omaha, Neb. September 12.

Bridges.—Iron bridges, abutments and approaches, over the Erie canal at Hudson and Austin streets, Buffalo, N. Y. Plans and specifications on file. JAMES SHANAHAN, Superintendent of Public Works, Albany, N. Y. September 13.

Water-Works Bonds.—For $100,000 5 per cent. bonds payable in 5, 10, 15 and 20 years. WM. L. CARLIN, Mayor, Findlay, O. September 13.

Levee.—Fulton lake levee in Desha and Chicot counties, Ark. Bids per cu. yd.; including all cleaning, grubbing and planting of grass. All information at the office of Capt. WM. T. ROSSELL, U. S. Engineer Office, 106 Madison Street, Memphis, Tenn., and at the office of the State Board of Engineers, New Orleans, La. WM. T. IVY, President of the Board of Levee Commissioners of the Tensas basin levee district, Rayville, La. September 15.

House.—Dwelling house at the Chestnut Hill pumping station. H. T. ROCKWELL, Chairman, Water Board, Boston, Mass. September 15.

Sewers.—New sewers, extensions, repairs and alterations. THE COMMISSIONER OF PUBLIC WORKS, 31 Chambers street, New York City. September 16.

Curbing and Flagging.—THE COMMISSIONER OF PUBLIC WORKS (*as above*). September 16.

Custom House.—At Port Townsend, Wash. Ter. WILL. A. FREBET, Supervising Architect, Treasury Department, Washington, D. C. September 19.

Dredging.—In the Liverpool level of the Oswego Canal, 35,000 cu. yds. also removing sunken logs, etc. Plans and specifications on file. JAMES SHANAHAN, Superintendent of Public Works, Albany, N. Y. September 20.

Canal Improvement.—Improving the Champlain canal; bailing, clearing, grubbing, excavation, masonry, lumber, coping, spikes, bolts, etc., also bridge abutment and superstructure. At Stillwater and Fort Edwards, N. Y. Plans and specifications on file. JAMES SHANAHAN, Superintendent of Public Works, Albany, N. Y. September 20.

Pipes and Castings.—Cast-iron water pipe: 800 tons of 30-in. (class A), 480 tons of 16-in. (class B); 100 tons of special castings. H. T. ROCKWELL, Chairman, Water Board, Boston, Mass. September 20.

Sewer.—Plans and specifications on file. HARRY M. FARNSWORTH, Village Clerk, Brooklyn, O. September 20.

Artesian Well.—At the Insane Asylum, Lagview, O.; depth, 500 ft., and price per foot additional. FRED RAINE, County Auditor, Cincinnati, O. September 21.

Iron Portico.—At the above asylum. Plans and specifications on file. FRED RAINE, (*as above.*) September 21.

Road Improvement.—Improving the county road from Reading to the Plainfield turnpike, Sycamore township. Plans and specifications on file. FRED RAINE, (*as above.*) September 21.

Water-Works.—At David City, Neb.; estimated cost, $12,000. A. A. RICHARDSON, Consulting Engineer, Lincoln, Neb. September 22.

Street Improvement.—The following proposals for the improvement of Charles street from Colerain to 5t avenue, have been received by the Board of Public Affairs, Cincinnati, O.; H. J. STANLEY is City Engineer:

MATERIALS.	QUANTITIES.	L. DAY.		J. VORHERR.		F. KIRCHNER.		J. O'BRIEN.	
Broken stone	970 cu. yds.	$1.45	$1,406.50	$1.49	$1,445.30	$1.55	$1,503.50	$2.00	$1,940.00
Crossings	720 lin. ft.	.62	446.40	.67	482.40	.65	468.00	.70	504.00
Curbs	2,110 "	.64	1,350.40	.67	1,413.70	.69	1,455.90	.70	1,477.00
Drain pipe, 12 ins	100 "	1.35	135.00	1.19	119.00	1.55	155.00	1.00	100.00
Flag gutters	2 200 "	.64	1,408.00	.67	1,474.00	.69	1,518.00	.70	1,540.00
Grading	4 500 cu. yds.	.30	1,350.00	.40	1,800.00	.44	1,980.00	.37	1,665.00
Bouldering	2,900 sq. yds.	.95	2,755.00	1.09	3,161 00	1.20	3,480.00	1.35	3,915.00
Re-bouldering	300 "	.05	15.00	.33	99.00	.50	150.00	.10	30.00
Re-setting old curbs	140 lin. ft.	.05	7.00	.05	7.00	.15	21.00	.05	7.00
" " flags	140 "	.05	7.00	.05	7.00	.15	21.00	.05	7.00
Rolling	5,800 sq. yds.	.06	348.00	.05	290.00	.05	290.00	.05	290.00
			$9,228.30		$10,298.40		$11,042.40		$11,475.00

Stone.—Stone for the construction of a lock in the Wabash river, near Mount Carmel, Ill. Amount to be expended, $18,000, including contingent expenses. Plans and specifications on file. Major AMOS STICKNEY, U. S. Engineer Office, Louisville, Ky. October 1.

Contracting.

Stand Pipe and Mains.—At Holmesburg, Pa., the Holmesburg Water Co. has awarded a contract for the stand-pipe to the Harrisburg Stove & Boiler Works of Harrisburg, Pa., for $5,200, and for 3-in. water pipe to the Warren Foundry & Machine Co., of New York, for $17,000.

Sewers.—*St. Louis, Mo.*—The following proposals for the construction of sewers in Joab street, Sewer District No. 10, have been received by the Board of Public Improvements, St. Louis. The bidders were F. Skrainka, G. Eyermann, P. Brennen and R. Wyckoff & B. Crean; the prices were as follows: Earth excavation, 25, 35, 30 and 30 cts. per cu. yd.; rock excavation, $3, $3.50, $3 and $3 per cu. yd.; brick masonry, $6.35, $7.50, $6.50 and $6.50 per cu. yd.; 12-in. pipe, $1.10, $1, $1.10 and $1 20 per ft.; 15-in. pipe, 80 cts., $1, $1.25 and $1 per ft.; 6-in. junctions, 60 cts., $1, 60 and 50 cts. each; 9-in. junctions, 80 cts., $1, $1 and 50 cts.; 12-in. junctions, $1, $1, $1, and $1.50; 15-in. junctions, $1.50, $1, $1, and $2; inlet stone, 65, 50, 60 and 70 cts. per sq. ft.; cast-iron, 3 cts. per pound in all four bids; wrought-iron, 5, 6, 3 and 5 cts. per pound; totals, $2,382.20, $2,399.15, $2,512.15 and $2,382.20.——For sewers in Arsenal street, Sewer District No. 27, the proposals were as follows: L. Grund, $1,152.81; F. Skrainka, $1,153.31; P. Brenner, $1,164.87; H. Ruecking, $1,184.41; R. Wyckoff & B. Crean, $1,350.21; G. Eyermann, $1,487.91.——For sewers in North Mill creek, Sewer District No. 22, the only bidder was G. Eyermann, $653.55.——For certain sewer inlets and outlet sewers, the only bid was from R. Wyckoff & B. Crean, $816.99.——For an outlet sewer to North Mill creek, Sewer District No. 22, the only bidder was G. Eyermann; 50 ft. of 15-in. pipe sewer, furnished and laid, $2 per ft., $100.

Cincinnati, O.—The following proposals were opened Aug. 31 by the Board of Public Affairs; in McGregor avenue, H. McErland, $10,218; Peter & Steele, $11,220.70; P. Gleason, $11,756; B. Barton, $11,993.60.——In Buchanan street; Peter & Steele, $1,991.50; P. Gleason, $2,017.50; C. R. Brown, $2,049.50; B. Barton, $2,169.——On Lebanon turnpike, Peter & Steele, $12,581.25; H. McErlane, $14,259.75; B. Barton (informal).——The following proposals were opened Sept. 1 for sewers in Clinton street. B. Barton, $36,468.20; Peter & Steele, $38,550.05; E. T. James, $43,183.86; R. G. Huston, $43,263.90; J. M. Peter, $43,904.

Kansas City, Mo.—The contract for the Vine street sewer has been awarded by the City Engineer to H. Allison, at the following prices: 88-in. and 90-in. brick sewer, $10.50 per lin. ft.; manholes, $50 each; 15-in. pipe, 62 cts. per ft.; rubble masonry, $4.40 per cu. yd.; concrete, $4 per cu. yd.; lumber, $20 per 1,000 ft. B.M.——The contract for the 17th street intercepting sewer was awarded to Smith & Mullins at the following prices: 48-in. brick sewer, $4.75 per ft.; manholes, $45 each; catch basin, $79; 15-in. pipe, $1.50 per ft.; rubble masonry, $4 per cu. yd.; concrete, $4.30 per cu. yd.; lumber, $40 per 1,000 ft. B. M.——The only bid for the construction of a sewer in Sewer District No. 150, was from Shaw & Pierson, as follows: 66-in. brick sewer, $2.50 per ft.; manholes, $45 each; rubble masonry, $4 per cu. yd.; concrete, $4 per cu. yd.

Portland, Ore.—Bids opened some weeks ago for the Johnson creek sewer were as follows: Bays & Jeffery, $45,424.94; M. Tierney, $50,000; James Frainey, $60,000. All the bids were rejected and the work was readvertised. The second list of bids was as follows: Thos. Mann, $47,946.50; Geo. Langford, $48,423.60; Brays & Jeffery, $48,498.98. The increased amounts are accounted for by the contractors on account of their having lost two weeks by the delay, which will run the work into the rainy season.

Toronto, Canada.—The Board of Works has awarded sewer contracts as follows: Rosedale creek, Robert Pollock, $98,901; Bloor street, John Blake, $9,887; Bloor street (next section), Adam Beatty and Joseph Frost, $36,176.

Montreal Canada.—The Road Committee has awarded contracts for the construction of sewers in St. Jean Baptiste village to J. Parker, at the following prices; $6.97, $7.50, $15.43, $16.93.

Cable.—The contract for the cable for the cable railway of the Essex Passenger Ry. Co., at Newark, N. J., has been awarded to the firm of John A. Roebling's Sons Co., of Trenton, N. J. The line will run from the Market street depot to the Springfield avenue car stables, and it is expected to be in operation by January.

Levee Work.—The following proposals for the continuation of construction and repair of the levee from Arkansas City, Ark., to Amos bayou, Ark., have been received by Capt. WM. T. ROSSELL, U. S. Engineer Office Memphis, Tenn.; Joseph Flynn, of Memphis, 34½ cts. per cu. yd.; Henry Duffin, of Memphis, 35 cts. The amount to be expended is about $66,500, less engineering and other expenses, and the work will aggregate about 360,000 cu. yds.

The Board of State Engineers, New Orleans, La., has awarded the contract for the first section of the Diamond Island Bend levee, to Peter Trezevant, the only bidder, for 25 cts. per cu. yd. The work includes about 200,000 cu. yds. of earth. A second section will be awarded on the 12th inst.

Lake Erie Harbors.—Maj. OVERMAN, U. S. Eng's., has just made his report to the War Department on the improving of Lake Erie harbors within his jurisdiction. At Cleveland, O., the work on the harbor, commenced in November, 1886, was seven-eighths done on June, 1887, including 1,200 lin. ft. of foundation work; the entire foundation work will be done this month. The total cost of this breakwater will be about $1,300,000, with $319,250 yet to be spent. At Toledo harbor, at least $150,000 will be needed in one season to complete projected improvements of the natural channel through Maumee bay. The cost of completing the straight channel is estimated at $1,875,000. At Sandusky $20,000 is wanted at once to complete projected improvements, and to increase channel depth to 16 ft., as at other harbors, would cost $61,000 more. Maj. OVERMAN thinks further outlay on Conneaut harbor injudicious unless land transport to the port is improved. At Fairport and Ashtabula $50,250 could be well expended in one lump.

Sewer Work at Topeka, Kan.—(*Specially Communicated*).—The city recently invited proposals for the construction of sewers in three new sewer districts, the total length of the sewers to be constructed being in all about 27 miles. The plan adopted is the "combined" system, and the sewers will be of sufficient size to admit of the removal of the surface water. The sizes above 24 ins. in diameter will be of brick and egg-shaped, and sewers of 24 ins. or less diameter will be of vitrified tile pipe. The contracts for about 14 miles of the work have already been let. C. J. Rosen, of Topeka, was awarded the contract for the brick sewers at the following prices:

1,280 ft. of	27 × 35 in. brick sewer		$3.15	per ft.
1,130 "	33 × 43 "	"	3.60	"
870 "	38 × 50 "	"	3.95	"
1,560 "	50 × 66 "	"	4.59	"
3,200 "	54 × 71 "	"	7.85	"
200 "	60 × 78 "	"	7.50	"
4-in. tile pipe			4.00	"
Manholes			49.00	each.
Catch basins			49.00	"
Rock excavation			2.50	per c. y.

The average cut was 18 ft., and the excavation in dry ground required no sheeting.

Decker & Mullen, of Kansas City, were awarded the contract for pipe sewers at the following prices:

33,600 ft. of	9 in. pipe sewer		$ .65	per ft.
21,200 "	12 "	"	.90	"
5,000 "	15 "	"	1.15	"
2,850 "	18 "	"	1.50	"
420 "	21 "	"	2.00	"
1,730 "	24 "	"	2.80	"
4-in. unglazed tile			.8	"
Manholes			50.00	each.
Catch basins			60.00	"
Lampholes			5.00	"
Rock excavation			3.00	per c. y.
Average cut on pipe sewers			13 ft.	No sheeting.

GEO. T. NEALLEY is City Engineer, and GEO. F. SAMUEL, Engineer of Sewers.

Water Works Material.—Col. E. R. DAVENPORT, who has the franchise for water-works at Pomeroy, O., will purchase the material from the National Tube Works Co., McKeesport, Pa.

Railroad Contracts.—*Clinch Valley R. R.*—Capt. H. Davin, of Lexington, Va., has the contract for the construction of about 8 miles of line, near Richland, Va. His contract includes 2 tunnels and 4 or 5 bridges.——J. C. Green, of Wytheville, Va., has a contract on this road.

Sheffield & Birmingham R. R.—Fudge & Kearn, of Jasper, Ala., have a contract for grading a part of this Alabama line.

Mississippi & Tennessee Rivers R. R.—The contract for the construction of the section of the road between Corinth, Miss., and the Tennessee river has been awarded to D. S. MCINTYRE, of Illinois. The right of way is to be given free.

National City & Otay R. R.—The contract for grading and bridging the extension from National City, Cal., up the Sweetwater river, has been awarded to the American Bridge Building Co., of San Francisco. Work is to be commenced at once and completed by November.

Water-Works Contracts.—*Worcester, N. Y.*—The contract for the water-works has been awarded to Francis Leonard, of Hobart, N. Y. There will be about 4 miles of 4-in. to 6-in. cast-iron pipe, 17 hydrants and 10 gates or valves. The works will cost, including lake, $30,000. Work is to be commenced at once and completed by December.

Seymour, Ind.—The following proposals for the construction of water-works have been received: American Water-Works & Guarantee Co., Muncie, Ind., $3,800 per annum for 8 miles of mains and 100 hydrants, or $4,190 per annum for 9 miles of mains and 113 hydrants; Seymour Water Co., $4,250 per annum for 9 miles of mains and 85 hydrants. The council unanimously decided in favor of the American Water-Works & Guarantee Co., and the matter will be put to the public vote on Sept. 13.

Sumter, S. C.—The contract for the construction of the water-works has been awarded to Jeter & Boardman, of Brunswick, Ga., for $50,000, and work will be commenced shortly. The supply will be obtained from an artesian well.

Levee Work.—The following proposals for the construction of the Kempe levee, Tensas parish, and Deer Park levee, Concordia parish, La., were opened Sept. 1, by Capt. DAN. C. KINGMAN, U. S. Engineer Office, New Orleans, La.:

	Kempe. About 600,000 cu. yds.	*Deer Park.* About 60,000 cu. yds.
Rogers & Ballentine	30 cents	—
McTighe & Co	38 "	17 cents
Ogden & Jones	28½ "	15 99-100
Robt. N. White	—	14¾
John P. Kennedy	34	16¾
Pat. Harnan	—	21
Wm. Curry	—	19½
Albert G. Ober	—	18
M. B. McGary	—	16 74-100
Robt. McNamara	28¾	17

Street Work.—*New York City.*—The following contracts were awarded by the Commissioner of Public Works, Aug. 30: Regulating, grading, curbing and flagging on 63rd street; James Slattery, earth and rock excavation, 75 cts. and $1.48 per cu. yd.; curbing, 58 cts. per lin. ft.; flagging, 25 cts.; total, $22,846.55.——Similar work on 150th street; J. F. Dawson, 25 cts. and $1.25 per cu. yd.; 60 cts., 40 cts., $9,289.——Curbing and flagging sidewalks on 5th street; Andrew Low (the only bidder) curb, 75 cts.; curb reset, 25 cts.; flagging, 25 cts.; total, $1,583.47.——Curbing and flagging on Manhattan avenue; Andrew Low; curb, 67 cts.; flagging, 24 cts.; total, $1,240.42.—Flagging on 151st street; T. F. Murray; flagging 26 cts.; total, $2,900.94.

Rochester, N. Y.—The Executive Board has awarded contracts as follows: East Main street macadam improvement; Whitmore, Rauber & Vicinus; macadam roadway, $2.88 per lin. ft., 24 ft. wide; new curbstone, 43 cts. per lin. ft.; 36-in. Medina flag and paving gutter, 77 cts. per lin. ft.; 11 ft. wide Medina crosswalk, $2.05 per lin. ft.; surface sewers, without trap, $19 each; lot laterals, $5.50 each; manholes, $3 each; total, $25,489.30. (Estimate, $32,000).——Warehouse street Medina improvement; Whitmore, Rauber & Vicinus; Medina roadway, $1.97 per sq. yd.; new curbstone, 43 cts. per lin. ft.; flag gutter, 13 ins. wide, 33½ cts. per lin. ft.; 5 ft. wide crosswalk, $1.92 per lin. ft.; flag crosswalk, relaid, 20 cts. per lin. ft.; main sewer, stone, cleaned, 20 cts. per lin. ft.; surface sewers, without trap, $34 each; surface sewers repaired, $14 each; lot lateral, $5.95; test pit, $7; manholes, $28 each; total, $7,837.95. (Estimate, $8,800.——Poplar street plank walks; Henry Goetzman; plank sidewalk, including grade, 4 ft. wide, 25 cts. per lin. ft.; plank crosswalk, including grade, 5 ft. wide, 45 cts. per lin. ft.; total, $198.75. (Estimate, $280.)——Hawley street plank walks; Henry Goetzman; plank sidewalk, including grade, 4 ft. 8 ins. wide, 20 cts. per lin. ft.; plank crosswalk, including grade, 5 ft. wide, 50 cts. per lin. ft.; total, $373. (Estimate, $1,075.)

Baltimore, Md.—The following proposals have been received for grading, curbing and paving the streets through the "old Bolton Depot property." James P. McGovern, grading 10 cts. per cu. yd.; curbing, 37½ cts. per lin. ft.; paving, 5 cts. per sq. ft.; 6-in. curb, $1 per lin. ft.; Wm. R. Weaver & Co., 13 cts., 38 cts., 5 cts., $1; Owen Patterson, 10 cts., 40 cts., 5½ cts. and 95 cts.; Patrick Reddington, 11 cts., 40 cts., 6 cts. and 90 cts. The contract was awarded to James P. McGovern, the lowest bidder. JAMES HODGES is Mayor, and A. E. SMYRE, City Commissioner.——The contract for grading, curbing and paving Wolfe street has been awarded to Patrick Reddington; grading, 14 cts. per cu. yd.; curbing, 40 cts. per lin. ft.; paving, 5 cts. per sq. ft., total, $14,006.65.

St. Louis, Mo.—The following proposals have been received by the Board of Public Affairs, for reconstructing with granite, Broadway, from Mullanphy street to Hempstead street: Allen & Vieths, taking up old paving and preparing roadway, $7 per sq. of 100 sup. ft.; 4-in. curbing, furnished and set, 85 cts. per lin. ft.; old curbing, taken up and reset, 20 cts. per lin. ft.; hydraulic concrete, 8 ins. deep, laid complete, $11 per sq. of 100 sup. ft.; granite block pavement, $30.50 per sq. of 100 sup. ft.; total, $29,823; Fred Skrainka, $6, 85 cts., 15 cts., $10, $33, $30,110.50; P. W. Schneider, $10, 85 cts., 25 cts., $10, $22, $31,855.50; G. Eyermann, $10, 90 cts., 20 cts., $10, $32, $31,952.——For similar work on Broadway from Hempstead street to Chambers street: Allen & Vieths, $18,196; Fred Skrainka, $18,366; G. Eyermann, $19,144. ——For similar work on Broadway from Franklin avenue to Biddle street: Henry Ruckert, $20,969.50; Fred Skrainka, $21,367; G. Eyermann, $21,772; P. W. Schneider, $22,572; Allen & Vieths, $23,169.50.——For similar work on Broadway from Biddle street to O'Fallon street; P. W. Schneider, $9,778; Henry Ruckert, $9,872; Allen & Vieths, $9,872; Fred Skrainka, $9,964.50. ——For similar work on Broadway from Chambers street to North Market street: Fred Skrainka, $21,924, Allen & Vieths, $22,133; G. Eyermann, $22,850.——For similar work on Broadway from North Market street to St Louis avenue: G. Eyerman, $21,928; Allen & Vieths, $22,135.

RAILROADS.

East of Chicago.

Existing Roads.—*Minneapolis, Sault Ste. Marie & Atlantic.*—The contractors on the line from the west boundary of Michigan to the Sault, 192 miles, are, Langdon, Henry & Co.; Coy, Kendall & Codd, Kennedy & Crampton; Wm. Doheny; and Drew, Lewis & Co. Track has been laid from Hermansville west 4.5 miles and east 2 miles; from Escanaba river east 5.5 miles; and from Trout Lake west 3 miles and east 10 miles.

New Brunswick.—On the Fredericton branch 16 miles, and on the Aroostook branch, 5 miles between Caribou and Presque Isle, Me., have been relaid with new steel this season. This makes the New Brunswick system wholly of steel, with the exception of the line from Watt Junction to St. Andrews, 28 miles.

Slate Run.—This road was built in 1886, and is located in Lycoming and Potter counties, Pa. The line is 10 miles in length, and though doing business as a common carrier, its principal use is as a lumber road. The line is 3 ft. gauge, and has a 30-lb. steel rail. It has a grade of 396 ft. to the mile for 2 miles, and rises 1,205 ft. in 6.5 miles. A. P. BOVIER, of Elmira, N. Y., is Chief Engineer.

Zanesville & Ohio River.—On this Ohio line 16 miles of track have been laid this year from McConnelsville to Luke Chute, and the grading has been finished ten miles farther to Waterford. Contractors are now working on the grading from Waterford to Harmar and also on the Shawnee & Muskingum River line running via Corning to Shawnee, 26 miles. The bridge over Wolf creek is to be a steel span of 195 ft. E. A. GREEN, Zanesville, is Chief Engineer.

Somerset.—The line from North Anson to Bingham, Me., 16 miles is nearly located and will be put under contract soon. A bridge is to be built across the Carrabasset river at North Anson 400 ft. in length. Piers are to be built this fall and the superstructure erected in the winter.

Marietta, Columbus & Northern.—Surveys are in progress for the extension from Sharpsburg, O., to McLuney's station on the Cincinnati & Muskingum Valley road, about 20 miles, and the line is to be put under contract at an early date.

Cleveland Akron & Columbus.—On the extension of this line from Killbuck to Dresden Junction, O., 24 miles of track have been laid. Work is progressing on the tunnel and the headings have been driven about 650 ft. The total length is 1450 ft.

Cleveland & Canton.—The proposed extension to Zanesville has been laid on the shelf for the present, though President BLOOD says it will ultimately be constructed. At present the $400,000 subscribed by the stockholders will be expended in work attendant on the change of gauge, which is to be effected by next spring.

New York & New England.—It is reported that W. H. STARBUCK, the recent purchaser of the New Haven & Derby road, will build a line from Derby to Waterbury paralleling the Naugatuck.

Boston & Albany.—Considerable work is to be done between Grafton and Westboro, Mass., straightening the line and lessening the curvature. The new location lessens the distance nearly a mile, and is nearly finished ready for the contractors. A new bridge is under construction at Lake Cochituate.

Central Vermont.—The company has agreed to build and complete the extension from Barre to Williamstown by June 1, 1888.

Pennsylvania.—It is stated that the present passenger terminals at Jersey City are to be given up in consequence of the failure to secure the City's permission to replace the present line with an elevated structure, and the company will build passenger terminals at the Harsimus Cove terminus, a half mile farther up the river, replace the present wooden trestle on the branch with an iron structure, and use the present passenger terminals for freight only.

Brockville, Westport & Sault Ste. Marie.—Work on this Canadian line has come to a stand still owing to lack of funds, but it is reported that contractor HARVEY has secured further aid and will "up and at it again."

New Projects and Surveys.—*Baltimore & Drum Point.*—The line of this Maryland road from Baltimore through the counties of Anne Arundel and Calvert, a distance of 75 miles, was surveyed about ten years ago, and is now being relocated preparatory to construction. $551,000 has been subscribed, and the right of way is nearly all secured. Contracts for construction will be let Oct. 1, the work to be completed two years from July 1. The work is generally light, the maximum grade is 63 ft. per mile. NICHOLAS GOLDSBOROUGH is Chief Engineer, OLIVER W. BARNES, of this city, is Consulting Engineer.

Baltimore & Eastern Shore.—The County Commissioners, of Talbot county, Md., have voted to submit an order for $50,000 aid to this project, to a popular vote at the November election.

Coshocton & Sandusky.—A line is projected between these Ohio cities to run *via* Jeromeville, Mt. Vernon and Ashland, a distance of about 100 miles. I. E. BARNEY, of Coshocton, is interested.

Canastota, Morrisville & Southern.—It is stated that a New York firm has offered to build this road on the basis of one-third cash to two-thirds bonds. The projectors are endeavoring to secure aid from the city of Syracuse, and if successful, will close the contract by Sept. 10.

Southern.

Existing Roads.—*Louisville Southern.*—Track-laying on this Kentucky line has begun and will be pushed on the line from Louisville to Harrodsburgh, 76 miles, on which grading is nearly completed. Lines are under survey from Lawrenceburg to Lexington, 25 miles, and from Harrodsburgh to Richmond, 30 miles, and will probably be placed under construction at an early date. Surveyors are locating the site for the bridge over the Kentucky river on the Lawrenceburg and Lexington line. The structure will be 1,600 ft. in length, and 255 ft. high. JNO. MACLEOD, of Louisville, is Chief Engineer.

Central of Georgia.—This company now owns and controls a railway system of 2,377 miles. This will be increased 300 miles by the extensions in Georgia and Alabama now under construction and survey.

Rome & Decatur.—This line has become financially embarrassed by the failure of the banking house of GROVESTEEN & PELL, of New York City. Hon. RUFUS DORSEY, of Atlanta, has been appointed receiver.

Georgia, Midland & Gulf.—This road is now completed and in operation from Columbus to McDonough, Ga., a distance of 98 miles.

Ripley & Mill Creek Valley.—This West Virginia road has been graded from the mouth of Mill creek on the Ohio river, to Ripley, 12½ miles. Contractors are working on the trestles and bridges, and as soon as completed track will be laid. A. J. VOSBURGH, Jackson C. H., W. Va., is Chief Engineer.

Lookout Mountain.—The work of construction of this line at Chattanooga, Tenn., is dragging, and the company proposes to put a portion of the grading under contract instead of the present plan of company work.

Louisville & Nashville.—It is rumored that a cut-off is to be constructed from Milan, Tenn., to Huntingdon, shortening the distance from Memphis to Nashville over this road by about 12 miles.

New Projects and Surveys.—*Gulf & Chicago.*—This proposed "air line between Mobile and Chicago" is still being presented to the attention of Mobile and other Alabama towns by Col. C. C. MERRICK and others, who are trying to secure subsidies to aid in the expenses of the survey. According to the Colonel's statement to the Mobilians, the line is to be built by "European capitalists" who wish simply that the cities along the route shall "chip in" a little toward the preliminary expenses merely as an assurance of friendliness to the enterprise. Another of the projectors stated that he "had always loved Mobile," and on the strength of this assurance a committee was appointed to solicit aid. Western towns are remarkable for their digestion of taffy.

and gush from railway projectors, but the Southerners seem to go them at least one better.

Carolina Knoxville & Western.—The Atlantic, Greenville & Western which has for some time been closely identified with this company has now been formally consolidated with it.

Mississippi & Tennessee Rivers.—It is stated that the contract for the building of the portion of this proposed line between Corinth, Miss., and the Tennessee river has been let to D. S. McINTYRE.

Savannah, Vernonsburg & Roseview.—A bill is before the Georgia legislature to incorporate a road by this name.

The Northwest.

Existing Roads.—*Lake Erie & Western.*—Tracklaying on the 40 mile extension to Peoria, Ill., is completed from Bloomington to the Mackinaw river where a 1 200 ft. bridge is under construction. The line is to be open for business by October.

Red River Valley.—The grading is completed on this now celebrated road, and tracklaying is to be pushed at once. The Canadian Pacific has adopted no new obstruction measures, and the silence is regarded as rather ominous by the Manitoba party.

St. Louis Alton & Terre Haute.—Contractors are making satisfactory progress on the extension to Paducah, Ky., and it is expected to reach that point by the first of next year. It is stated that this road is to be closely identified with the Huntington system, and will form its St. Louis connection.

Chicago & Northwestern.—It is reported that work is to begin at once on the line between Doland and Iroquois, Dak.

St. Paul, Minneapolis & Manitoba.—Track is laid on the Montana extension 425 miles west from Minot and within 125 miles of Great Falls.—A large force is at work grading the line for a quadruple track between Minneapolis and St. Paul.

Wisconsin Central.—A Duluth rumor is to the effect that this company is negotiating for an entrance to Duluth over the Northern Pacific, and that if not successful they will build a line of their own to that city.

New Projects and Surveys.—*Cairo & Northwestern.*—This company has been incorporated in Illinois to construct a railroad from Cairo to East Cape Girardeau. HENRY WELLS, of Cairo, is among the incorporators.

Decatur & Western Nebraska.—This company has been incorporated at Decatur, Neb., to build a railroad from that city to the west line of the State. W. E. DRURY is interested.

Duluth Terminal.—A. N. MILLER has been elected President of this company, recently incorporated at Duluth, Minn.

Missouri River, Roscoe & Duluth.—This youthful Dakota project will wisely close its career by uniting with the Forest City & Watertown Co.

Green Bay & Kewaukee.—The citizens of Kewaukee, Wis., have voted to give $30,000 to any railroad company who will build a line from Green Bay to Kewaukee direct.

The Southwest.

Existing Roads.—*Atchison, Topeka & Santa Fé.*—The Kiowa extension is now completed and in operation to Canadian City in the Texas Panhandle.—The $10,000,000 of new stock issued a few weeks ago, has all been taken, and applications have been filed for a million more.

Chicago, Rock Island & Pacific.—On the extension southwest from Greensburg, Kan., the line is located across Indian Territory, and surveyors are at work on the Texas Panhandle.—The lease of the Union Pacific's track between Kansas City and Topeka has gone into effect, but regular trains will not be put on until Oct. 1.—It is reported that a trackage right is to be secured over the Quincy, Missouri & Pacific from Trenton, Mo. to Quincy, but it is not easy to see very great gain in this move, unless the company goes further and secures an entrance to St. Louis.

Memphis & Little Rock.—This Arkansas company has just been reorganized, and it is said will soon do something on the projected extension to Dallas, Tex.

St. Louis & San Francisco.—It is reported that the final location of the extension from Paris to Roberts, Tex., 80 miles, is near completion and the work is to be put under contract at once.

New Projects and Surveys.—*Leavenworth & Denver Short Line.*—This project, which has its headquarters at Leavenworth, is being boomed with true Kansas fervor. Its backers are engaged in a determined effort to raise $10 000 for making a preliminary survey. JOHN WILSON, is President.

Montana, Kansas & Texas.—The St. Louis *Globe-Democrat* says that this project includes a line from Galveston, Tex., to Miles, Montana, about 1300 miles, that part of the line is located and the survey is in progress. One A. L. TEMBLIN, of Stanburg, Mo., is named as the President and General Manager, but our belief in Mr. TEMBLIN'S existence in general and in the greatness of his railroad in particular is allayed by the discovery that there is no such post office in the United States as Stanburg. We are tempted to wonder if people who rely on newspapers for information regarding railway matters actually swallow such stories as this without mastication.

Chicago, Kansas & Arkansas.—It is reported that a preliminary survey has been made by this company from Wathena to Lawrence, Kan., and from Oskaloosa to Lecompton.

Arkansas & Grand Prairie.—G. M. BARBOUR, of Chicago, is President and General Manager of this Arkansas project.

Kansas City, Lawrence and Nebraska.—Another corps has just been put in the field by Messrs. BREITHAUPT & ALLEN, Chief Engineers, to run the preliminary surveys from Randolph, Kan., to Hastings, Neb., while the first party will continue work on the eastern part of the line, between Pottawatomie Co. and Kansas City. About 80 miles have been run, including the roughest part of the line, and no serious difficulties encountered.

Rocky Mountain and Pacific.

Existing Roads.—*Chicago, Burlington & Quincy.*—The company has purchased the Denver, Utah & Pacific road extending from Denver to Lyons, Col., 43 miles, and will probably go on with its projected extensions to Laramie.

Oregon & Transcontinental.—The greatest surprise in the stock market of the present week, except of course the Baltimore & Ohio deal, has been the sudden appearance of HENRY VILLARD with several millions of foreign capital for aiding this company out of its straitened financial condition. The present relations of this company with the Northern Pacific indicate that not much of the energy of the company, now that it is on its feet again, will be directed toward its original purpose of constructing feeders to the Northern Pacific. It will be likely, however, to take hold of some of the proposed lines which the Oregon Railway & Navigation Co. recently chartered and will be apt to crowd into Northern Pacific territory in so doing, the very thing which it was the company's original purpose to prevent.

Northern Pacific.—On the Helena Boulder Valley & Butte line, trains are now running to Boulder, 17 miles from Jefferson.—A determined fight is to be made for the control of this road at the next election, and it will be then decided whether or no the road is to be handed over to the tender mercies of its whilom friend, the Oregon & Transcontinental.

Southern Pacific.—The preliminary surveys are finished for the Shingle Springs & Placerville road, and grading is to be pushed at an early date.—A double track is to be built to Port Costa at an early date.

New Projects and Surveys.—*Port Townsend & Southern.*—This company has been incorporated at Port Townsend, W. T., to build a railway to Portland, Ore. Surveyors are to be put on the line at once.

Oakland, Alameda & Laundry Farm.—This company has been incorporated by J. H. WOODWARD, the San Francisco agent of the Wabash, and others, to build five miles of railway in Alameda and Oakland, Cal.

Bridges, Canals and Etc.

New Bridges.—*Talcottville, Conn.*—An iron bridge is to be built across the river at a cost of $1,900, to replace the present worn out wooden bridge, which would cost $500 to repair.

Hartford, Conn.—The dispute over the bridge to carry the New York & New England R. R. tracks across Church street, which it had been claimed was not a highway, and for which a 16 ft. arch had been ordered, has been settled. The Board has ordered that "instead of the 16 ft. arch heretofore ordered at Church street there be erected a bridge commencing at the line established at the north boundary of the arch and extending south 40 ft., with supporting columns either in the center or at other points as may be hereafter provided so as to reduce the depth of girders under the bridge as much as may be done with safety, leaving 12 ft. in the clear above the present grade of said Church street, the plans to be hereafter approved by the board." The tracks of the New York, New Haven & Hartford R. R., which also cross the road, will be dealt with afterwards.

Titusville, N. J.—An iron bridge is to be erected near here by the County Commissioners, Trenton, N. J.

Newark, N. J.—The Kearny Township Committee has decided to petition the Board of Chosen Freeholders of Hudson county to provide a new free bridge across the Passaic river, near the foot of Fourth avenue, Newark, connecting this city with Kearny. At present the residents of Kearny suffer inconvenience in reaching the opposite side of the river, as they are compelled to travel a distance of two miles or more by way of the Harrison and Newark bridge. Their discomfort is often still further aggravated by the annoying delays occasioned by the draw on the bridge.

Philadelphia, Pa.—The Market street cantilever bridge over the Schuylkill river is rapidly approaching completion. Work was commenced last fall and it was hoped it would be completed by November but Superintendent LIPSCOMB is doubtful as to whether the iron work will be completed by that time and the construction of the cement roadway and sidewalks, with the erection of railings, gas lamps, etc., will consume probably another month. When finished the structure will be 732 ft. in length and 77 ft. in width. The sidewalks will be 12½ ft. wide, leaving a roadway of 52 ft. from curb to curb. B. A. Malone & Son, who have the contract for constructing the bridge, have sub-let the iron work to Cofrode & Saylor, of Pottstown. F. J. AMWEG, the designer, is also Engineer in Charge. Not less than 4,500,000 lbs. of iron will be used.

Baltimore, Md.—The new Charles Street bridge over the Falls at Union Station has been completed. On the four pillars at the bridge entrances are brass tablets bearing the following inscription: "1887. Jones' Falls Commission; Hon. JAS. HODGES, Mayor; A. E. SMYER, City Commissioner; C. H. LATROBE, Engineer."

Ashtabula, O.—An iron truss bridge will be built by the Lake Shore & Michigan Southern R. R.

Nashville, Tenn.—Work is progressing on the substructure for the new bridge. The second coffer-dam has been placed. There will be 3 masonry piers and 1 iron pier. The abutments and embankments will be finished in a few weeks, and then if the second coffer-dam turns out all right everything will be in readiness for the iron work at the time presented in the contract, the first of November. It is expected to finish the great bridge by April 1st.

Chattanooga, Tenn.—Work has been commenced on the erection of a $200,000 bridge over the Tennessee river at the foot of Market street. The necessary stock for building the bridge was raised in the city, and a contract awarded Aug. 25, to the Decatur Iron Bridge & Construction Co., of Decatur, Ala. It will be an elegant structure about 1,500 ft. in length. It is built for the Chattanooga Bridge Co.; President, J. L. MOORE; Vice President, I. B. MERRIAM; Treasurer, C. E. STIVERS; Secretary, R. M. BARTON. There will be 5 spans, a draw with two 120 ft. openings, and two trestles.

—The Anderson Bridge Co. has also been incorporated to build a bridge over the Tennessee river. A street railroad is contemplated across the bridge. The incorporators are C. C. ANDERSON, J. S. LINDENTHAL, R. W. PRICE, C. L. MORRISON and C. F. BATES.

Moultrieville, S. C.—R. A. KINLOCH, E. W. MORSE, and others, are interested in a scheme to build a bridge to connect Sullivan's island with the mainland at Mount Pleasant; to cost about $20,000.

Montgomery, Ala.—The South & North R. R. Co. is erecting an iron bridge across the Alabama river. The bridge is to be completed by January.

Menominee, Mich.—A bridge will be built by the County Commissioners at a cost of $60,000.

Peoria, Ill.—A special election was held recently for the purpose of obtaining the public sentiment in regard to the construction of a new free bridge across the Illinois river. About half a full vote was polled, and it was practically unanimous for the bridge. The structure will cost $50,000.

Cheyenne County, Neb.—The County Commissioners Sidney, Neb., have been asked to submit a proposition to the people at the coming election to vote $45,000 in bonds for the purpose of building three bridges across the North Platte river.

Cornell, Ont.—The three-center arch for the Michigan Central R. R. has the masonry laid to springing and will be finished Nov. 1.

The Resaca Canal & Manufacturing Co. has been incorporated at Resaca, Ga., by S. H. BROWN, and and others, to construct a canal from the Conasauga river to the Oostanaula river.

A New Pacific Coast Port.—A new scheme is announced for a third port of entry for Los Angeles, Cal. A recently incorporated Santa Ana valley syndicate will improve the natural harbor at Newport Landing, and make it one of the best ports on the coast. The work can be done without very great expense. Newport is 10 miles from Santa Ana, and 43 miles from Los Angeles.

The Provincial Iron Bridge & Railway Co. is to be incorporated in Quebec, Canada, by JOHN BREAKEY, lumber merchant, of the parish of Saint Jean Chrysostome; GEORGE DEMERS, merchant, of the parish of Notre Dame de la Victoire; ETIENNE SIMARD, notary, of the parish of Saint Romuald d'Etchemin; ALPHONSE CHARLEBOIS, contractor, of the City of Quebec, and PIERRE MALCOMN GUAY, physician, of the parish of Saint Romuald d'Etchemin.

The Owensboro & Indiana Bridge Co. has opened an office at Owensboro, Ky., and also opened its books for subscription to the $3,000,000 capital stock of the company. It is stated that the bridge will certainly be built, the directors having assurance that the money will be ready when required.

The Sioux City Bridge Co. has been incorporated at Cedar Rapids, Ia., by MARVIN HUGHITT and J. B. REDFIELD, with a capital stock of $2,000,000, to build a bridge across the Missouri river at Sioux City.